ENGINEERING NEWS

THE AQUEDUCT BOARD, at its meeting of Sept. 19, received from Controller MYERS a resolution calling upon the Chief Engineer to present a report at the earliest possible moment, showing by authoritative data the time of completion of the new aqueduct; its capacity, supply demanded, amount to be derived from present sources and all new sources, including the Sodom and Muscoot dams and the Bronx river, the estimated cost of the Quaker Bridge dam, time of the completion of this dam and all further information necessary to enable the board to judge understandingly of the necessity for its construction.

Mr. EUGENE E. MCLEAN of the Controller's staff sent in with his resolution a report, in which, while, he admitted that for the purpose of utilizing the entire yield of the Croton watershed, estimated at 400,000,000 galls. per day, the Quaker Bridge dam and reservoir would ultimately have to be constructed, still he held that it was a work that would not be needed for 25 or 30 years, and believed it ought to be left to the next generation to construct. He said that the Quaker Bridge dam and reservoir would cost $15,950,000, and that the construction of the reservoirs in the upper watershed would cost but $5,160,000, and these would supply the needs of the people for 30 years to come. The resolution and report were referred to the Construction Co mittee to be considered in connection with the report to be submitted by Engineer CHURCH.

THE MT. KELSO TUNNEL scheme is being revived. This project was started in 1880 by Mr. M. M. POMEROY of New York, with the combined purpose of shortening the railway route through the Rocky Mountains in Colorado, working veins of silver and gold lying in the path of the tunnel, and draining mines lying above the working level. The tunnel would enter Mt. Kelso at Bakersville, Col., at an elevation of 10,000 ft. above the sea, and it would be about 5 miles long, terminating at the small mining village of Decatur on the west slope. The contract for the tunnel is reported as let to Mr. THOMAS VERNON, C. E., 7 Westminster Chambers, London. But from the form of the prospectus and the inducements held out, mining and not railway tunnel driving seems to be the primary object of the projectors.

CONGRESS has at last made suitable provisions for guns and fortifications, although as usual it has not met the estimates submitted. One project has called for the expenditure of $126,377,800 on forts and built up guns, while another asked for about $36,000,000, with liberal reference to construction on other systems. The bill enacted allows $6,500,000 for gun contracts, of which only $2,000,000 can be expended in any one fiscal year. Provisions for the maintenance and repair of forts and for expenses of the Engineer and Ordnance departments are in addition. The long struggle over Watervliet Arsenal is ended, and $700,000 is appropriated to fit it up for finishing guns of large calibre, and in accordance with the long submitted views of the Gun Foundry Board. The attempt to make 14-in. and 16-in. guns is posponed, and the appropriations confined to those of 8-in. 10-in. and 12-in. calibres. But the Fortifications Board estimates that our sea-coast and lake frontier need only 6 14-in. and 44 16-in guns, against 102 8-in. 222 10-in. and 208 12-in. It is therefore plainly wise not to attempt the larger calibres at once.

THE APPROPRIATION OF $1,500,000 for the purchase of steel forgings for guns, does not seem to be a very liberal amount. The Fortifications Board having estimated $28,554,000 as needed for guns and mortars for our coast defense, besides $9,411,800 for carriages. The Senate proposed $,5,000,000 for this purpose, but $1,500,000 will buy more forgings than the Watervliet factory can finish for several years. The tools and machines for finishing the guns as well as the steel must be made in this country. Another appropriation of interest is that of $250,000 for steel-hooped, cast-iron, breech-loading 15-in. mortars; and while the Fortifications Board asked for 700 mortars they get 50 to 100. Fifty 10-in. and 50 12-in. steel breech-loaders may also be bought complete on satisfactory tests. This last is one of several provisions encouraging private gun manufacture. The board of army officers constituted by the bill may buy multi-charge guns, and also two field guns of aluminum bronze, and expend $500,000 in experiments with guns, carriages, projectiles, and other war material. $500,000 is appropriated for pneumatic or other dynamite guns and other incidental purposes. It looks as if our disgraceful helplessness against attack by some great power like Chili was not to continue much longer.

THE ALLEY ELEVATED ROAD OF CHICAGO has forfeited to the city the $100,000 guarantee placed in the hands of the Controller. The reason is a non-compliance with the terms of the contract, Chicago papers say this road, legally known as the Chicago & South Side Elevated Railroad Co., will not be built for 2 years.

ELEVATED RAILWAY QUESTION IN PHILA.—The Phila. *Press* very sensibly suggests to the Councils of that city that if the elevated railway question was submitted to a board of engineering experts instead of being thumbed over by councilmen who know less of its merits as a means of transport than the effect upon bordering real estate, the problem might be soon solved. Other cities have settled the question definitely in one direction or the other, but the *Press* says that the Councils of Philadelphia go at each proposition as if it was a new issue never dealt with before. Just now another plan is before them from an old company.

BRIDGE ACCIDENTS are reported as follows:—On Sept. 16, the floor gave way on a bridge near Sprague, W. T., under a freight train. The bridge has been considered unsafe for some time.——Sept. 19, a number of freight cars on the Santa Fé Railroad went through a bridge near Bellville, Tex.——On the same day a highway bridge over the Quinsigamond river, at Grafton, Mass., collapsed.——Sept. 20, a partly constructed bridge at Paducah, Ky., over Cross creek, gave way, severely injuring several workmen, one fatally. A large number of smaller bridges have been washed away in Alamance Co., North Carolina, in the vicinity of Glencoe, Big Falls and Cedar Cliff.

THE STORMS during the week have done considerable damage in New Hampshire, Massachusetts, New York and Texas. Near Laredo, Texas, 26 ins. of rain fell in 3 hours, if the reporter of the *Galveston News* is to be believed, carrying away 100 yds. of the Rio Grande & Eagle Pass, R. R. tracks, including a dump and 100 car-loads of gravel. Heavy rain caused an embankment to cave in at Amherst, Mass., necessitating the construction of a trestle; and washouts have also occurred on the West Shore, Housatonic, Central Massachusetts and Boston & Albany Railroads. A freshet at Waupaca, Wis., carried away part of the dam furnishing power for electric lighting, destroying the main building and all the machinery.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was caused by a gravel train on the Chicago & Northwestern running into a passenger train on the Chicago, Burlington & Northern, on Sept. 19, at East Winona, Wis., at which point these roads cross each other. Two coaches were thrown from the track, and one, a Burlington sleeper, was wrenched from its trucks and thrown diagonally across both tracks with the floor smashed in and one car of the construction train wedged under it. The engine and tender of the gravel train were thrown down an embankment and badly wrecked. One of the Burlington coaches jumped about 20 ft. from the track and landed in the water. The engine, baggage car and one coach were not disturbed. There were 12 persons severely injured, one fatally.

OTHER ACCIDENTS have been: Two derailments in Texas during the past week were caused by cows being on the track. One on Sept. 21, on the Texas Central, at Steel's Creek gravel pit, and the other on the Aransas Pass, near Boerne, Sept. 24. Serious injuries resulted from both collisions, one passenger being killed outright in the latter.——A south bound passenger train was wrecked by a freight train 6 miles south of Hannibal, Mo., on the St. Louis, Keokuk and Northwestern, Sept. 19, in which the engineer of the passenger train was killed ——Sept. 18, the Wabash express collided with 2 box cars which had been left standing on the main track between Catlin and Fulton, Ill. One was killed and 3 severely injured.——Sept. 20, strikers on the Wabash Western Railroad, wrecked a freight train near Bridgeton, Mo., by spreading the rails at a switch and inserting a piece of iron in such a way that the train could not keep the track. The rails were displaced to wreck the Burlington passenger train, but this being an hour late, the freight was sent out ahead of it and met the fate intended for the belated train. The engineer and fireman were killed. A second attempt was made to wreck the train containing the physicians and officers who were returning from the first wreck, by placing a log across the track, but the train was stopped in time to prevent the disaster. Freight train collisions and wrecks have occurred on the Cleveland, Lorain & Wheeling, at York, O.; Maine Central near Bangor, Me.; Chicago, Burlington & Quincy, near Galesburg, Ill.; New York, Pennsylvania & Ohio, near Akron, O.; West Shore, near Catskill.; Baltimore & Ohio, near Belleville, O.; a double collision on the Denver & Rio Grande, and on the Pennsylvania Railroad, at Harsimus Cove, Jersey City, Sept. 20.

AN OBLIQUE HEAD COLLISION on the Elevated on Wednesday night of this week, at almost the most crowded hour, illustrated the beauties of such disasters in a very satisfactory way, giving a very effective warning without doing any serious damage. The accident appears to have been the direct effect of the carelessness in employès naturally engendered by the constant habit of being closely sandwiched between adjacent trains.

An empty up train had left the 59th St. Station to take a switch at 64th St. to the middle storage track. It had passed the switch, but just before the switch was thrown for it to take the siding, and while the switch was displaying a white light, a following train was started from 59th St. crowded with passengers. It is alleged that the following engineer was a "calculator", and allowed that the preceding train starting to back down on the switch about as he started from the station, he would just have time to clear its rear as it backed off the main track, and have the switch thrown right for him. Whether this is so, or whether he failed to observe the red light indicating that the switch was wrong, or whether the lights were wrong, or whether there was some sudden delay to the leading train does not clearly appear, nor is it important. The essential fact is that the following engine struck the train backing down on the siding obliquely, between the third and fourth cars, lifted them off their trucks, which were knocked into the street, and had the crowded leading car of its own train tipped over at an angle of 45°, and only saved from falling into the street by the switch post and a frail hand railing. In the mean time a third, down train was coming along, and before it had time to check its speed sensibly ran into a switch house which had been overturned upon the down track. The speed of the colliding train was slow, or much more serious consequences would have resulted.

THE YELLOW FEVER scare is having a serious effect upon the railways of the South. On many of the local lines in Florida, Alabama and Mississipi all trains have been abandoned; and the rigid quarantine established on short notice by the cities of Memphis, Chattanooga, Montgomery, and the State of Texas and a host of small towns has blockaded freight and almost entirely stopped the passenger traffic on the through lines. In Mississippi it is reported that in some instances mobs have torn up the track or have resisted the passage of trains with firearms. In view of the fact that the only cases of yellow fever in the whole Lower Mississippi valley were a few at Jackson, Miss., the stopping of all rail way communication, including the United States mails, by mob violence seems without excuse. The virtual stoppage of passenger traffic all through the South will temporarily cut down the earnings of all lines to a very low figure. But it is altogether probable that the rush of business which will succeed the blockade will make up for the present losses.

THE BOSTON SOCIETY OF CIVIL ENGINEERS at its meeting on October 17, 1888, will discuss "Rapid Transit in Boston." The discussion will be opened by a short paper by Mr. HENRY MANLEY.

The Denver Water-Works.

BY S. FORTIER, B. A. SC., A. M. CAN. SOC. C. E.

(Concluded from page 223.

Source of Supply.—Cherry creek, like most western creeks, contains little or no water on the surface at certain dry periods of the year, but is subject to sudden and violent floods which agitate the sand to a number of feet in depth. Experiments were begun early in the summer of 1886 on the east bank distant about 8 miles from the center of the city and consisted in sinking well No. 2, (Fig. 7.) The sand was removed by teams to the water surface, which was about 8 ft. below the ground surface. The crib work of the well was built up in part and then weighted with sacks filled with sand and, as the sand was taken from the bottom of the inside, gradually lowered.

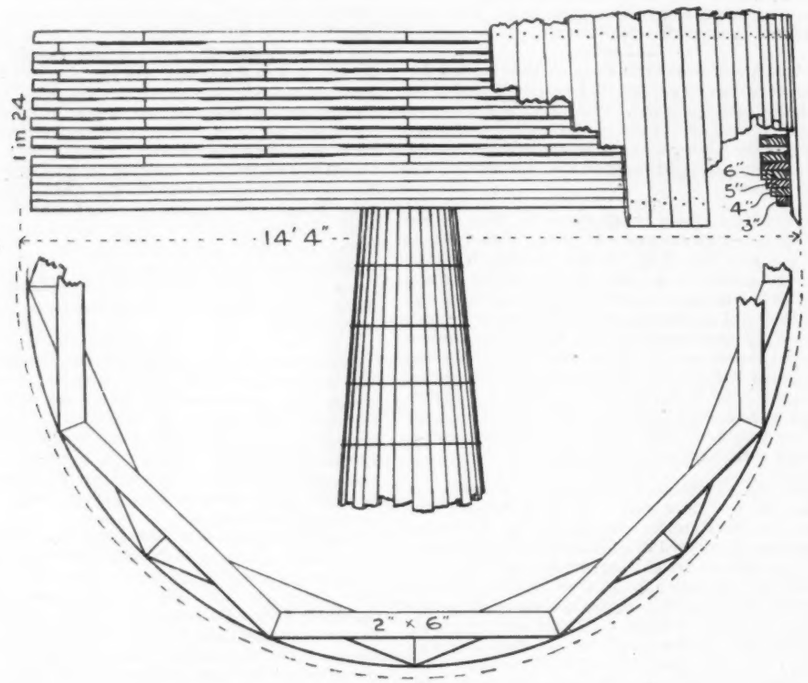


Fig. 7. Well No. 2; Gravity Supply, D. W. W.

A number of test wells were dug down to the water line in the vicinity and particularly along the route of the proposed conduit, and the fall of the water in these wells noted during the six weeks pumping test out of the large well. The results, shown by daily weir measurements, were more favorable than at first anticipated, and formed a basis of calculation for the total amount of water likely to be obtained as well as the size of the conduit to convey it. Before the conduit was completed from the sand gate, to be mentioned hereafter, to well No. 3, the water surface in the latter varied from 13 ft. to 14 ft. above grade line. The pipe as it enters this well on grade from the city side is enlarged to 4 ft. and terminates in the bell-shaped end of a cheap low pressure 4 ft. valve which regulates the supply at the source. Out of the far side, also on grade, a section 30 ft. in length of wooden piping was laid to serve as a connection between the cribbing beyond and the well.

This crib-work was built up of mill-run 2 in. x 4 in. Colorado lumber in the manner shown in Figs. 1 and 2 and extends to the actual bed of the creek, 264 ft., where it is again connected to 30 ft. of piping from well No. 3. Then for a length of 250 ft. piping alone, containing numerous 2 in. well points, lies under the bed where it was thought the sand when agitated by high floods might silt up under the cribbing and partially choke the water channel. On the far side and joined to the latter, 241 ft. of arched cribbing brings the underground system nearly across the sandy bed to within 30 ft. of well No. 4, from which it branches up the creek 162 ft. to the present terminus, although admitting of being extended any length in future if required. Well No. 1 is 438 ft. down the line, and was sunk to tap a body of water beneath the grade line. Wells 1, 3 and 4 are each 10 ft. in diameter and constructed of 2-in. x 6-in. rough lumber cased with oak (Fig. 7) to within several feet of the ground surface where hard burned brick is used to raise it near the surface and form a low arched roof, except in the case of the large well 14 ft. in diameter which is bricked above high water level, protected by an embankment of slag, and admits of easy access through a door.

These wells vary in depth from 20 to 25 ft. below the ground surface, and each one encloses a second perforated well tapering from 30 ins. to 12 ins., the small end rising a few inches above grade and the tube reaching down near bed-rock, which is here over 35 ft. deep. The horizontal wells vary in depth below the surface from 13 ft. to 16 ft. and the cost per lineal foot exclusive of excavation was $2.10; but the work being done in midwinter in more or less water, the cost was higher than it would otherwise have been.

Pipe Material.—While a conduit of cast-iron pipe would have proved more durable, yet from its enormous cost compared with other material, its use, from an economical view alone, could not be considered; a cement piping or salt-glazed vitrified pipe came within the range of practicability but had to be abandoned, chiefly for two reasons. (1) To have run so near a hydraulic grade line as to insure safety against bursting, would have very much increased the length of the conduit. (2) 30-in. cement piping was the largest manufactured in the State. The material, therefore, was limited to either wood or wrought-iron. A conduit, 3 ft. internal diameter of No. 18 sheet-iron would have cost about 40 per cent. more than wooden piping, and it is doubtful if its durability would have been as great, owing to the large percentage of acids and alkalies present in Colorado soils. It is true the pipe is coated with asphaltum; but the experience of many has been that in riveting the sections, pieces of the coating were knocked off and so exposed the thin wrought-iron to the action of this somewhat peculiar soil. The conduit was, therefore, made of wood in a manner similar to that designed by Mr. ALLEN for the Platte river pipe, which had proved in every respect efficient.

Its size to allow for a subsequent increase in the supply was to be 37 ins. and capable of discharging 10,000,000 U. S. galls. per day, although the amount obtained since completion, has seldom exceeded 5,000,000 galls. In the deep cut, 3 in. Colorado pine was inserted and 2-in. staves in the remainder. In depressions native lumber, being always saturated with water, was preferred, and California red-wood on the higher elevation; while a union of both was in places effected by building the upper portion of red-wood and the lower of pine.

The bands (Fig. 5) were ½-in. round iron and after being bent on a table to the proper form, were coated. In a series of tests made at the pumping works, the minimum pressure at which the first band broke was taken as the breaking weight of the iron and after deducting 600 lbs. for stress due to tightening the bands, one-third of the remainder was adopted as the safe stress for each band. In construction the bands were spaced according to the internal pressure with this factor of safety of three, thus making the pipe at the bottom of a depression equally strong with that on grade line. This, of course, caused the cost to vary from $1.10 and $1.20 on grade line to $1.40 and $1.50 in dips, which does not include excavation.

Pipe Line.—A line of levels being run from well No. 2, to Cemetery Hill showed a total fall of about 14 ft. in over 5 miles and a general grade of $\frac{1}{10}$ per 100 was established; owing, however, to depressions and other causes, the pipe in several places does not come up to grade line. For the first 7,513 ft., it is laid on a grade of $\frac{1}{10}$ to a shallow ravine, where a sand gate was constructed to by pass the water into a 30-in. cement pipe laid nearly at right angles to the main line, from which the water flowed into an open ditch and was weired. It was at this low point

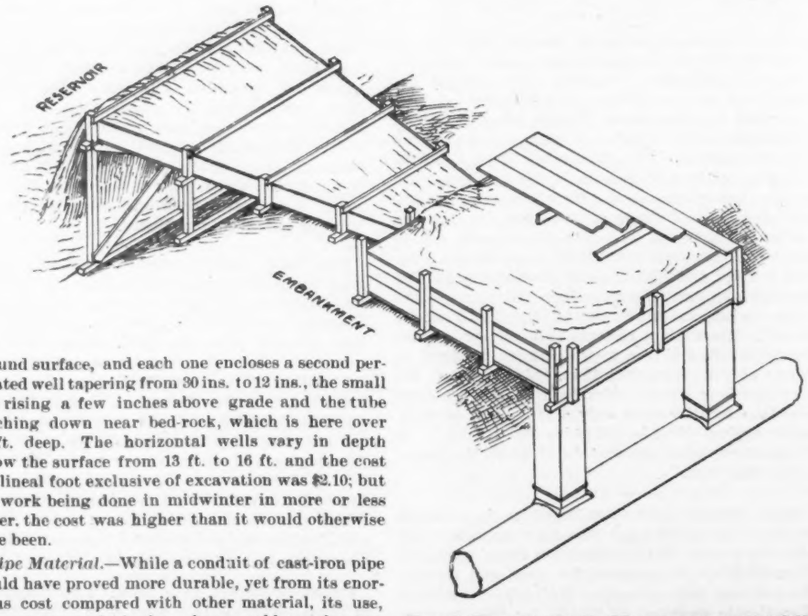
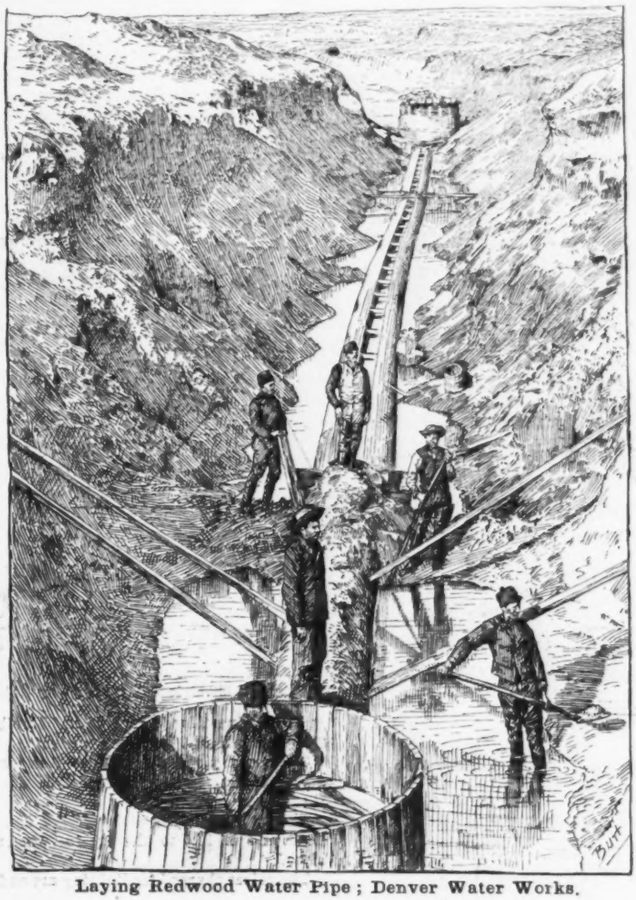


Fig. 8. Weir for Daily Measurement; D.W.W.

where piping was first put in and extended up towards the source. Little or no difficulty was occasioned by water in the ditch until within 800 ft. of the bank when a layer of clay was cut through, after which the pipe was laid in 12 in. or 18 in. of water. The deepest cutting lay in this portion and increased from 9 ft. to 21 ft. near the well, the material consisting chiefly of fine sand and although

liable to slide had it not been frozen, was in no instance sloped more than 1 to 1. As before stated, thicker staves were used to ensure safety against



Laying Redwood Water Pipe; Denver Water Works.

the heavy load of saturated earth above. From the sand-gate down, the conduit rises in 900 ft. to true grade and then continues on a $\frac{1}{5}$ fall for some 2 miles. Then it descends about 25 ft. in the first dip, thence rises to within a few feet of grade, and again descends in a dip 45 ft. deep and over a mile wide, after which it rises to a height of 1 ft. above the water in the reservoir into which it empties. The average cutting in this latter portion does not exceed 6½ ft. and few difficulties were encountered save those experienced in obtaining the best location when running on grade. To procure 2 ft. of covering over the pipe on the one hand, and to avoid expensive excavation on the other, a number of curves varying from 230 ft. to 500 ft. radius were run in. One of those, a 22° 30′ curve, is shown in "ENGINEERING NEWS" April 28, 1888, and is from a photograph at the time of construction.

Reservoir.—(Fig. 3). The reservoir in connection with the new plant was begun in August, 1887, the city having used the Cherry creek supply from June preceding until the reservoir was completed, directly through the 37 in. pipe. The vicinity abounds in what is popularly termed *alkali beds*, derived from decomposed gypsum. Although liable to become very plastic and yielding when first wet this makes a safe embankment when well puddled, the greater part of the alkali being washed out in the process.

The surface area when full is 120 ft. × 559 ft., depth 20 ft, with a fall along the bottom of 18 in., outer slope 2 to 1, inner 1½ to 1, width on top 14 ft. raised 3 ft. above water and a capacity of over 7,000,000 gals. The contract was let for 12 cts. a yd.; and one of the provisions in the specification was that the material should be put on in layers of not over one foot in depth, each layer being well puddled at the company's expense by means of water pumped into a 6-in. pipe laid round the edge of the outer slopes to which fire hose were attached. Water was turned in early in 1888 and it has remained more or less full since, except during 10 days in April when it was drained to allow the posts of the roofing to be set. It was, I believe, the intention of the Chief Engineer to have it lined with brick, stone, cement, or thin cast iron plates cemented together, but as no inconvenience has arisen from the water being retained by puddled embankments when roofed over, it may not be done at once. The water is so clear that one can readily see to the bottom, through a depth of 15 ft. to 18 ft. and so thoroughly filtered that it retains its true color, that of clear ice.

The inlet pipe with weir box, weir and apron are shown in Fig. 8, the main idea held in view in construction being to agitate and thus aerate the water as much as possible before passing into the reservoir after flowing through so long a length of conduit. This is fairly well effected by allowing the water to fall over the weir, where it spreads out in a thin sheet on a broad apron, and finally falls into the reservoir at a minimum height of one foot, but often, as is the case when the reservoir is partially emptied, of 6 ft. and 8 ft. When completed, a pipe will lead from near the crest of the weir to the care-taker's house, and will have a float and recording gauge within the building. A valve house is built directly over the main conduit at the lower end and nearly in the center of the end embankment. This is shown in Fig. 9, and was originally intended to be made of boiler iron braced with 40 lb. rails, but masonry 2 ft. in thickness was afterwards substituted. It is 26 ft. high and contains the 37-in. valve with a cheap balance valve attached, two ports for the 24-in. inlet pipes, and grooves for oak flash-boards, besides an air pipe on the city side of the valve.

Reservoir Roof.—The roofing of reservoirs, even in the East and particularly in the West, is as yet of rare occurence; judging, however, from the successful issue of the Denver Water Company's experiment, it will become quite common in the towns and cities of Colorado. The estimates obtained from the Edge Moor Iron Co. for an iron trussed roof with corrugated sheet iron covering was $37,000 for material and $7,500 for erection. As this sum was greater than the company desired to expend, a flat wooden roof was designed and erected which cost approximately $5,000 (see Fig. 10). Five tiers of posts 22 ft. between centers are ranged lengthwise or from N. to S. of reservoir. The posts in the 3 inner tiers are 6-in. × 6-in. × 24 ft., rest on mud sills 2 ft. to 4 ft. in the earth and rise to within 15 in. of the top of the embankment, where they are surmounted by a 3-in. × 8 in. × 16 ft. cap running in the same direction; while those on the outer tiers are 5-in. × 5 in. × 16 ft. and are similarly anchored and capped. The joists 3-in. × 12-in. × 22 ft. are placed on the cap over the posts and stretch E. and W. across the reservoir, their upper edge being on a level with the top of the embankment, and the extreme ends resting on a 2-in. × 12 in. sill placed along the inner edge of each embankment.

To strengthen the sheathing, which is of inch boards, 2 in. × 4-in. pieces are run in between every pair of joists and are supported by the bridging and cap, a board 16 ft. long being in this way supported in 5 places and fastened down with 11 barbed steel 16 d. wire nails.

No precaution was taken to have the sheathing close, the space between the boards varying from ⅛ in. to 1 in. To provide against too severe a strain on the roof by a heavy fall of snow, about one-fifth of the total area consists of trap doors fastened down on one edge with screws, which are to be removed and the doors raised every fall.

Growth of Algæ.—Ever since the company abandoned a settling basin and artificial filters and began to use the purer water from the underground systems, they have experienced considerable trouble by the growth of the lower forms of vegetation. The reservoir near the pumping works had at first merely an earthen bottom and sides; but as the algæ grew so abundantly it was deemed necessary to pave it

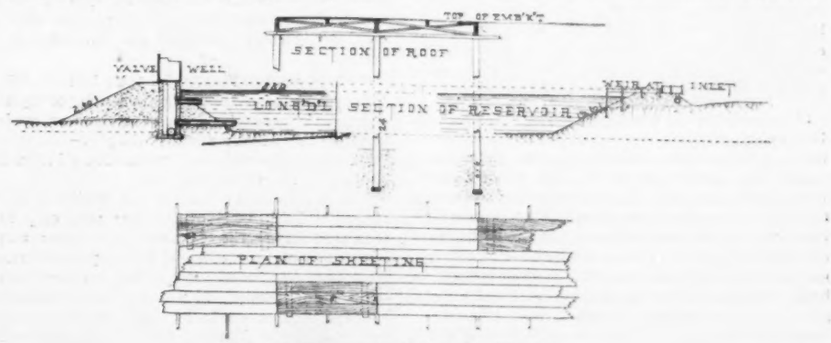


Fig. 10. Reservoir Roof; D. W. W.

with stone cemented together, both with a view of partially preventing the growth and to facilitate cleaning. This was done at a cost of about $10,000; but instead of diminishing it rather increased the amount of vegetation, which has to be removed four or five times in each year at an annual expense of nearly $600. It may be here mentioned also that in the fore-bay and canal forming the outlet of Lake Archer, not over 100 ft. distant from the reservoir, *no vegetable growth ever accumulates*, which would seem to show that water having the larger bulk of its sediment deposited as is the case with Lake Archer water, still contains enough foreign matter to destroy vegetable germs.

While constructing the roof over Cemetery Hill

reservoir during hot weather in the early part of last June, when only a space of 44 ft. in the center remained uncovered, algæ began to grow in 12 ft. and 14 ft. of water under the exposed surface. When rising from the bottom to the surface it appeared like a small sponge, but lost its form when removed from the water and was reduced to a few fine filaments. With the completion of the roof and the consequent exclusion of sun-light, all such growth ceased to exist nor has any been observed since, although our summer here has been the hottest in ten years. From the above facts the company would have been obliged, had they not roofed the new reservoir, to have paved it at a cost of about $6,000 and removed the vegetable growth at a probable cost of $400 a year, while the water would have been less pure.

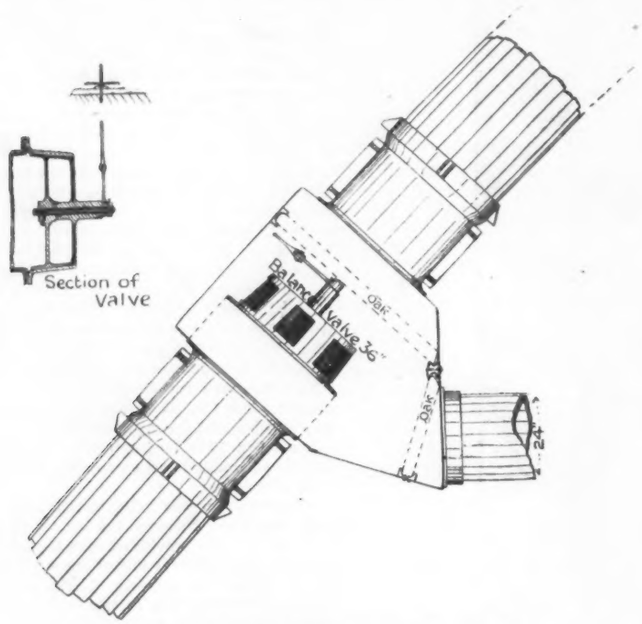


Fig. 9. Valve-Arrangement; D. W. W.

The wooden mains from the reservoir to the city are composed wholly of red-wood. There are 3,984 ft. of 37 in. wooden mains reaching beyond the stand-pipe, where it branches into a 24-in. wooden main, 4,015 ft. long, running west toward the pumping works and ending under a head of 113 ft., and a 30-in. wooden main going north 3,208 ft. where it connects with a 16-in. cast-iron main under a head of 120 ft.

Stand-Pipe.—The stand-pipe, shown in April 28, 1888, in this journal, is of somewhat novel construction. A large casting with two horizontal and one vertical bell ends to admit the ends of the wooden pipes forms the base. The tubes which brace the stand-pipe and provide an overflow for the surplus discharge are built in three sections, 6-in. interior diameter at base, 5 ins. in center and 4 ins. at top and rest on 8 tons of masonry at each corner, so bound together with rods and cast-iron plates, as to give a safe anchorage. It being placed in an exposed position, it was built to withstand a wind pressure of 60 lbs. per sq. ft of surface exposed.

The new Cherry Creek plant, including the wells at the source, 30,314 ft. of 37-in., 3,708 ft. of 30-in. and 4,015 ft. of 24 in. piping, with reservoir and stand-pipe has been cared for since completion by one man. His chief duty is to regulate the amount of water flowing out of the reservoir into the city to suit the variable domestic and fire demands At first this was done by operating the 37-in. valve, but as this was inconvenient and involved much labor, a balance valve, shown in Fig. 14, was bolted to the flange of the former, which is now kept open and its duty performed by the small attached valve which can be opened or closed in a minute's time by the pressure of a few pounds.

Streets in the Olden Times.

An article contained in the *Deutsche Bauzeitung* gives the following description of the condition of streets in former centuries:

"But few cities had paved streets before the Christian era, and the most of them were not improved in this manner until the 12th or 13th century. For instance, the city of Paris had no paving before the year 1184; in the reign of PHILIP the Second. The first city in Germany which had its streets paved, was Augsburg, a wealthy and growing city. The improvement was brought about at last by a wealthy merchant who had paving put down in the street in front of his house; this was so much admired that all the streets were paved and paid for by the city.

"Many of the finest streets of London had no paving before the 15th and 16th century, and the city of Berlin was only partly paved in the first half of the 17th century. It is evident that it was impossible to clean the streets before any paving was put down. Pigs were permitted to run at will about the city and greatly increased the filthiness of the streets.

"When young PHILIP, in 1131, lost his life, by falling from his horse, which was tripped by a pig running between its legs, an effort was made to prohibit the running about of the pigs—but in vain. This failing, the order was given that a bell should be hung to the neck of the pigs.

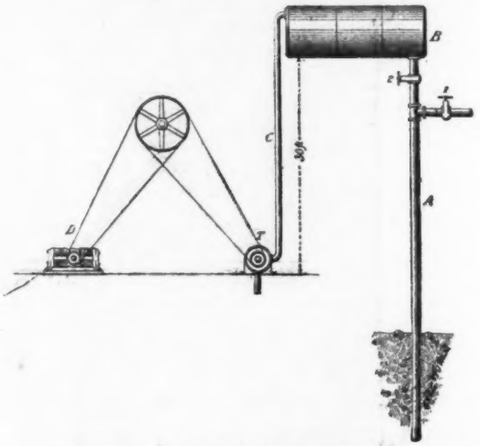
"To arrive at an idea of the condition of the streets of Paris at that time, one need only to be reminded that in the 14th century, a person was allowed to pour or throw anything upon the streets from door or window; it was only required to call out, 'stand aside!' It was not until somewhere between the years 1372, and 1395, that this custom was stopped in Europe, while in Edinburg this practice was kept up until 1750.

"It was not until the year 1609, that the whole city of Paris was cleaned by the municipal authorities; previous to that time the expense of cleaning was met by the citizens. By a contract made for six years, dated in the year 1748, the annual sum of about $40,000 was paid for removing the filth, and for snow, about $1,200. In the year 1595, the city of Hamburg already had a scavenger system in operation.

"It was not until the year 1600 that the streets of Berlin were cleaned; in this city the pigs were also running about loose; the pig-styes were often put upon the walk, directly under the windows of the houses. In 1681, it was forbidden to keep pigs upon any part of a street."

A Remarkable Electric Light Plant.

Our readers will recall the curious source of power for some of the dynamos of the lighting plant connected with the Ponce de Leon Hotel, at St Augustine, Fla. This consists of an artesian well, the water of which drives the dynamo. That installation, however, does not stand alone, being equalled, if not exceeded in its remarkable character, by the installation of the Yankton Electric Company, of Yankton, D. T. The source of power there is a flowing well 600 ft. deep, and the arrangement of the plant is shown in the accompanying sketch. The water comes up through a 6-in. casing *A*, and passes into an old boiler *B*, which acts as a trap to catch the stones which are sometimes thrown up by the well. A pipe *C* leads to a 12-in. Fleniken turbine *T*, with a fall of 30 ft.



Driving an Electric Light Plant by Artesian Well

The turbine, which is controlled automatically by a Pritchard electric govenor, drives the dynamo of the Weston type.

The pressure in the boiler *B* is 7 lbs. under full head, and 57 lbs. to the sq. in. when the well is closed.

The prices charged for lighting are as follows:

ARC.			
1	$ 15	per month	Dark till midnight.
2	28	"	
10	125	"	All night.
INCANDESCENT.			
1 to 8	$1.50	each per month.	
9 to 15	1.25	" "	
16 or more	1.00	" "	

The renewals are furnished by the subscriber on the basis of 600 hours life.

The present plant of 30 h.p being inadequate to supply the demand, a second well will be sunk at once.—*The Electrical World.*

Sir FREDERICK BRAMWELL, as President of the British Association, took as the peculiar text of his late inaugural address the phrase "Next-to-Nothing"; but a more expressive title would have been that of the "Eulogy of the Civil Engineer" and the value to science of his works. While Sir FREDERICK handled his subject as delicately as possible before this mutual admiration society of scientists, the gist of his remarks was that pure science did little towards advancing the material interests of mankind, and that there were men in the world who would drink heartily to the toast of—"Here's to the latest scientific discovery. May it never do good to anybody". Among other illustrations tending to prove his statement the speaker contrasted the interesting but commercially valueless discoveries of FARADAY with the practical results of the work of EDISON and men like him who laid no claim to being scientists. The whole address pointed to the fact that it was attention to detail that made engineering successful and "advanced science", and not a mere general statement of theories and laws. While a scientist might indicate why certain effects should follow certain conditions, it was the engineer who practically applied his experience and skill in showing how certain useful results were to be most directly obtained.

The Trans-Caspian Railway.

While we have already had considerable to say on this subject, M. RYMKIEWICZ, in a late number of *Le Genie Civil*, gives additional matter which is worthy of reproduction, and particularly so in the general map herewith presented, which will enable the reader to grasp the general railway situation in Asia, better than anything we have yet met with.

M. RYMKIEWICZ gives the history of the Trans-Caspian Railway, which lately reached Samarkand, as follows :—In 1873 M. CHARLES COTARD conceived the project of a direct railway line between Europe and India, and through M. FERDINAND DE LESSEPS, authority was obtained from the Russian Emperor to make the preliminary studies of the route. In 1875 M. COTARD exhibited the results of his work in a proposed Central Asiatic railway which he hoped would eventually extend from Paris to Calcutta.

Unfortunately, the powerful personality of M. DE LESSEPS was turned in a different direction, and this grand scheme was at least delayed. Ten years later Russia recognized the necessity of establishing railway communication between its widely separated territory in Central Asia; and in a few years it constructed the line, commencing at Kizil Arvat at the Caspian Sea end, by way of Merv, to Samarkand; a line which it is now extending to Tachkend, as shown on the accompanying map.

Russia has thus actually built the first link in the grand railway system which must sooner or later control Central Asia and eventually cross the continent to the Pacific ocean. The execution of this Trans-Caspian line was confided to Gen. ANNENKOFF, a clever diplomat and builder, who gained his experience as chief of the mobilization of the Russian army and commandant of the military railways in the war with Turkey, in 1876. Thanks to his skill and energy, 2 years were sufficient to construct 310 miles of railway and to equip it, at a total expense not exceeding about $26,000 per mile.

The establishment of a railway in a country as arid and inaccessible as is Central Asia differs essentially from similar construction in a region provided already with ways of communication and all the resources of the mechanical arts. This railway had literally to be built from one end, and the road as it progressed was the only means of transport and supply. This condition required a perfection of organization and discipline in his working force that reflects the greatest credit upon the executive ability of Gen. ANNENKOFF.

The Trans-Caspian Railway starts at Ouzoun-Ada, a port on the river Est emptying into the Caspian Sea and directly opposite Baku on the west shore of this sea. The road then traverses the Turkestan plain, and at 894 miles distant from the starting point it strikes Samarkand at the foot of the high Pamir plateau. This great Turkestan plain is in great part a desert, with moving sands and some alluvial and clay soil; there is very little vegetation. The want of water stopped the Russian army 7 days march from the Caspian Sea; and to avoid like trouble a second time, the Russian Government, between March and November, 1881, built the 144 miles of railway from Mikhallovsk, on the Caspian, to Kizil Arvat.

It was not until 1884 that the Russians were seized with the idea of extending this line to Samarkand and Tachkend. Gen. ANNENKOFF again took the direction of affairs, and commencing in May, 1885, he finished in 28 months 750 miles of railway. The table below gives the designation of the several sections of this road and their length, and the time occupied in their construction :—

Ouzoun Ada was selected as the terminus of the line on the Caspian, because it had a minimum depth of water of 10 ft., while the port of Mikhallovsk had only 6.6 ft. While the 10 ft. may be objected to as too shallow, it must be remembered that the port of Astrakhan, the chief port on the Caspian Sea, has only 9 ft. of water. All the vessels on this sea, including 1,200 sailing vessels and 150 steamers, are constructed with a view to entering the port of Astrakhan; there are only 6 steamers of a greater draught, and these trade on the south coast of the Caspian Sea.

While it is impossible to give the entire cost of construction, as the final details have not yet been made public, the figures below show the relative cost on the last 750 miles of construction.

The grading amounted to little, except between Merv and Tchardjoui. The average amount was about 7 cu. meters per lineal meter, or nearly 15,000 cu. yds. per mile. The average cost price was about 11 cents per cubic yard.

TABLE No. 1. CONSTRUCTION NOTES.

	Section Name.	Length: Miles.	Construction Dates. Commenced	Finished.	Time: Months.	Remarks.
(1)	Ouzoun-Ada to Mikhallovsk	16.12	May, '85	July, '86	14	This section built to reach the port.
(2)	Mikhallovsk to Kizil Arvat.	143.8	March, '81	Dec. '81	10	Built after the military campaign of 1879.
			Interval of 4 years.			
(3)	Kizil Arvat to Merv.	348.4	May 18, '85.	July 2, '86	14	Second campaign of construction.
			6 weeks rest.			
(4)	Merv to Tchardjoui.	153.7	Aug. '86	Dec. '86	4	
			Interval of 10 months.			
(5)	Tchardjoui to Samarkand.	231.9	Sept. '87	July, '88	10	Interval consumed in gathering material at Tchardjoui for the bridge across the Amou Daria, and in surveys between that point and Tachkend.

TABLE No. 2.—COST.

	Class of Expenditure.	Total cost.	Cost per mile.
1	Surveys	$45,980	861.30
2	Right of way	128,200	171.01
3	Grading	1,621,400	2,161.80
4	" Accessory	152,400	203.28
5	Masonry, bridges, etc	677,000	902.13
16	Stations, shops, etc	556,600	742.13
17	Guard houses, barracks	205,700	274.27
18	Water supply	605,000	806.66
19	Rails	6,195,200	8,260.02
10	Rolling stock	1,815,000	2,420.00
11	Transport of rails and mate'ls	726,000	968.00
12	Ties, laying and ballasting	4,452,800	5,803.73
13	Accessories to track	459,800	613.07
14	Telegraph	217,800	290.40
15	General Expenses	1,694,000	2,258.70
	Totals	$19,553,000	$25,936.60

The grading force was for the greater part recruited from among the natives of the country; they were under the control of soldiers and were paid the very modest wages of about 10 cents per day. They were permitted to carry the earth, etc. in the skirts of their scanty dress; and to this practical method of utilizing native labor is to be attributed in a great measure the rapidity of the work. It was found better to increase the number of workmen, rather than to put into their hands unfamiliar tools, or to change their ordinary methods of labor. Gen. ANNENKOFF always had in reserve a sufficient number of workmen to push over any particularly difficult section and thus to avoid delay and any interruption of his rapid march. For this reason, at times the number of laborers reached 30,000 men. Our author adds in passing, that the Imperial star glittering upon the white helmets of the officers contributed much towards rendering these natives docile, and the regular payment of their wages at the close of each day made them confident of the end.

One of the most serious obstacles met with was the want of water. The only considerable streams on the route were the Tedjend, Mourgale and Amou Daria: excepting these three rivers the desert is traversed only by a very few minor water courses and the river Larafchane near the end of the line, between Tchardjoui and Samarkand.

Around these water courses are grouped the tribes of cultivators, who irrigate their lands by *norias* and dams. But the ground thus watered yields surprising crops: they have nine cuts of *luzerne*, obtain ten times the volume of the seed in cereals, and in their vineyards get 1,920 lbs. of grapes per acre. It would thus appear that while the Trans-Caspian railway is a strategical line, it can at the same time become a powerful instrument in the development of the country it traverses.

The native rock between Kizil Arvat and Donchak, near Merv, was calcareous and made good lime, and masonry of a very excellent class was thus possible within reasonable expenditure. The line has 61 stations in all, in which this stone was more or less used. All openings of from 6 to 40 ft. had stone abutments and piers with wooden stringers. These openings are few in number until the Amou Daria is passed; but beyond that river to Samarkand they average six to the mile. The bridges over the rivers mentioned are of wood. The bridge over the Tedjend has a length of 353 ft., and rests upon 20 pile piers of 6 piles each at intervals of about 16½ ft.; the track stringers are wood. The second bridge over the Mourgale has an opening of 200 ft., but the third bridge over the Amou Daria is much more important; it has a total length of 13,776 ft., of which however, only 6,225 ft. are in the bed of the river proper. This bridge is a pile bridge like the others, and was built in 3¾ months at a cost of $160,000, not including the transport of material.

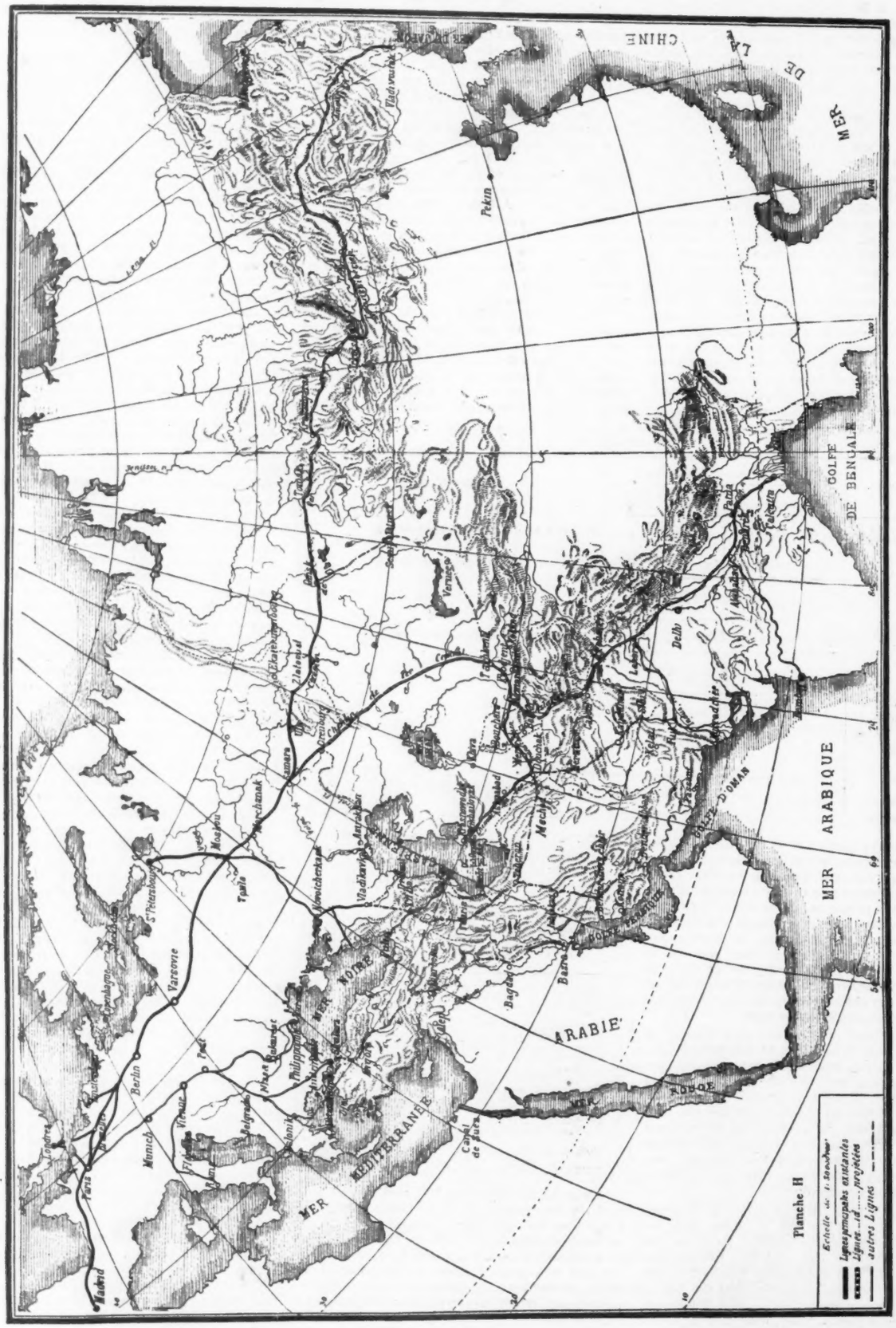
The track laying gang was divided into two brigades of 150 soldiers and 300 to 600 natives, according to circumstances; or 1,000 to 1,500 men in the two gangs. All these men were lodged in trains following the track, of 50 to 55 cars, some of them with two floors or stories. A special train of 5 or 6 cars carried Gen. ANNENKOFF and his staff.

At intervals of 5 or 6 miles along the line there were turn-outs serving as depots for the loading of the construction train with material sufficient for about 1¼ miles of track. This train was usually made up of 9 platform cars with rails, 18 with ties, for track accessories and about a dozen cars carrying bridge and station material, water, food, etc. The movement of these trains was so regulated that they were able to send out three complete trains per day and thus lay 3.72 *miles of track daily*. During the delay at the Amou Daria, Gen. ANNENKOFF improved upon his track-laying plant by providing his platform cars with a series of outside rollers, arranged in such manner that the rails and ties could be rapidly slid along to the head of the train and then on to small trucks, with the result of saving expense and time in the unloading and picking up again. The ties and all wood used in construction came from Russia, from the neighborhood of the Kama; and the rails were of Russian manufacture furnished by the Government at a cost of $80 per ton; the rails weighed 64 lbs. per yd.

The rolling stock was also Russian, and consists of 80 Siegl locomotives and 1,400 cars of all kinds. The engines are arranged to burn petroleum fuel of which a certain amount is found in the country traversed. As now operated, the trip from Moscow to Samarkand can be made in 6 days.

Such is the work that has been accomplished with a rapidity which will astonish every one who closely studies the development of the ways of communication which Russia is progressively extending towards the East of its empire. This nation is now occupied with grander projects still, as indicated on the accompanying map, and in which Gen. ANNENKOFF is again designated as the executive head.

The greatest of these lines, the Trans-Siberian, has a length of 3,720 miles, in passing from the Ural to Vladivostok on the Sea of Japan. The second project is a line connecting the Trans-Siberian and the



The Railway Situation in Asia; with European Connections.

Trans-Caspian railways, from Omsk to Tachkend, a distance of more than 620 miles. This latter line, or the Central Asiatic, will doubtless be built from Orensburg to Tachkend, thus giving an all rail route from St. Petersburg to Samarkand, instead of breaking the journey, as now, in passing across the Caspian Sea.

CORRESPONDENCE.

[For additional Correspondence see page 251.]

The Wm. Penn Statue.

[W. E. M. writes us that the bronze statue of St. CHARLES BORROMEO, at Arona, Italy, is 66 ft. high, and is thus higher than the proposed statue of WM. PENN, at Philadelphia, or the German statue of HERRMANN. But, as we understand it, the BORROMEO is made from hammered copper plates as was the Statue of Liberty in New York Harbor; while the HERRMANN and the PENN are cast bronze, and it was on *cast* statues that the comparison was based.—ED. ENG. NEWS.]

Prevention of Pipe Freezing.

CHIPPEWA FALLS, Wis., Sept. 20, 1888.

EDITOR ENGINEERING NEWS:

In answer to "J. W's." conundrum of how to protect pipe from freezing will say that at Chippewa Falls a six-inch pipe is carried across the Chippewa river on the sidewalk of the bridge, a distance of 960 ft., and has been there 3 winters without trouble; the mercury having been 46° below zero at times. There were only 5 consumers on the pipe the first winter.

The pipe is enclosed as follows: The outside box is 28 ins. square outside, made of one inch matched stuff, then a two inch air space and another square box constructed like the last, then a two-inch space filled with mineral wool, then another square box constructed as other two, then the pipe wrapped in 3 thicknesses of felt paper and having, of course, the balance of the room in the inside box as an air space.

This was constructed against my protest, I feeling sure that it would freeze, but it has not. Total cost was about $600; it took 9400 lbs. of wool at 3 cents per pound.

All water pipe here are laid 8 ft. deep to top of pipe, and sometimes freeze at that.

E. T. ABBOTT.

The Cascade Bridge.

31 CHAMBERS ST., N. Y., Sept. 25, 1888.

EDITOR ENGINEERING NEWS:

In Mr. CLARK'S article in your last issue, on the Cascade bridge, he corrects my geography, so far as to place the mouth of Cascade creek a mile *south* of the Pennsylvania State line, whilst in my article of Sept. 1, it is stated as a "short distance north" of this boundary.

In preparing the article of Sept 1, I was desirous of giving the "whereabouts" of this creek, as many who have traveled the road were ignorant of its location, and if I, myself, ever knew the name of the county in which its outlet in the Susquehanna river is situated (which is very doubtful) I had forgotten it, and before appearing in print, was careful to consult the best authority in my possession, which happened to be the sketch map, without scale, accompanying Commissioner's Report to Legislature, Jan. 4, 1847, of the rival interior and river routes. On this map, believed to be authentic, neither the Cascade nor the Starrucca creeks are named, as at that date they were without significance; but the Gulf Summit and Lanesboro, Penn., between which two points the railroad crosses these creeks, are given, as also the names and boundaries of the adjacent counties in both States, and I had little difficulty in arriving at the conclusion, that the Cascade "was a short distance north of the State line." A reference to this map will show that I was not so far "at sea" as your correspondent would make it appear*. However, Mr. CLARK, as engaged on the State boundary survey, is undoubtedly correct in this matter.

With reference to this ignorance of County or State lines by engineers, someone (not now recollected) has said, that "names are things", and one engaged on boundary surveys might wonder that so important a "thing" in his eyes, as a "blaze" or peculiar stump, should be ignored by anyone with a surveying instrument in his hands; but he might recollect that such marks would not naturally find place, either as "things" or "names" in the note-book of a constructor.

That the tunnel around the bank at the Cascade bridge was the crowning *act* of the sapient contrivers of the entire scheme, there is no doubt whatever, although it may have entered into their original plan as a *dernier ressort*, only in case their "blind drain" failed. Your remarks, however, leave nothing further to be said on this point.

J. W. ADAMS.

*The official Post route map of N. Y. & Penn. on a scale of 6 miles to the inch, compiled by the topographer to the P. O. Dept., Washington, D. C., 1868, places the cascade valley north of the State boundary line, in Broome Co., N. Y.

The Best Method of Keeping Transit Field Notes.

NEW YORK, Sept. 24, 1888.

EDITOR ENGINEERING NEWS:

A constant reader of your valuable journal wishes to point out that the method of keeping transit field notes which appears in your current number is by no means new, and must be used by many engineers besides Mr. BURGESS. You say in your note "this method is unquestionably preferable to all others, although given in no field book." The method is fully explained in *your own* FIELD-BOOK FOR ENGINEERS; No. 2 ENGINEERING NEWS Popular Library, at page 55, on "keeping transit notes", which is a reproduction of matter which was published 12 years ago in your journal. The explanation is very lucid, and the section is well worth reproducing, now that the matter is brought up. X.

[This is another of the many gratifying evidences which come to us from time to time that it is hard to get ahead of ENGINEERING NEWS, or to duly appreciate how really, truly good a paper it is. It is true, we find, that the method which we thought so new, and which we still think so good, was described in full in a series of articles by the late Prof. CHARLES A. SMITH, C. E., of Washington University, St. Louis, which appeared in ENGINEERING NEWS for 1876: and from page 277 of our issue of Aug. 26, 1876 we reprint what "X" well describes as Prof. SMITH'S lucid explanation.

In 1886 we concluded to reprint the old "CROSS' Field-Book", first published in 1855, which had been long out of print, more for the sake of giving one or two useful tables not otherwise accessible and in considerable demand than for any other reason. With this we incorporated Prof. SMITH'S article and some other matter, and the whole was published and is still for sale at 25 cts. We should never have thought of presenting this compendium as "our field-book", but we find that, not only was this method, which we thought so new and good, given by Prof. SMITH, but it is also the one given by Mr. C. S. CROSS in his little Field-Book which we republished.

We can only add that the method has never become general, and that "our" field-book appears to be the only one in which it is to be found. It is not given in either HENCK, SHUNK, SEARLES or TRAUTWNIE, as we have noted elsewhere. The following is the extract referred to:—ED. ENG. NEWS.]

KEEPING TRANSIT NOTES.

(Reprinted from ENGINEERING NEWS of Aug. 26, 1876.)

The transitman has after all a hard place to fill, for there is no variety in his mental work; he has to keep a sharp watch on the men when his superior is absent, and has the constant computation of deflection angles to attend to on curves, at the same time using all possible diligence as to figures. And here a hint as to the easiest way of keeping the curve notes and doing the transit work. *The method originated we know not how, and may have been used by large numbers of transitmen, although we have never happened to meet them.* [Italics ours. ED.]

The basis of all circular curve work with the transit is the well known theorem: The angle between a tangent and chord, or between any two chords which meet at a point on the curve, is measured by half the intercepted arc. And as the point where the chords meet on the curve may be anywhere on that curve, it follows that the sum of any consecutive angles or series of angles is the same no matter where the instrument be placed on the curve for given arcs, and that if the deflection angles be all computed from the *P. C.*, as far as may be desired, at any station on the curve the number can be used, as the differences will be the same for the same stations. To illustrate this, we must assume an example.

Let it be required to run a 5° curve from sta. 131+40, and let us first look at a page in a field book:

Stations.	Deflections.	Curve.	True Course.	Needle Course.
129			N 16¼° W	N 16° W
130			N 16° 15′ W	
P. C. + 40	0°0′	5° R.		
2	1°30′			
3	4°0′			
4	6°30′			
5	9°0′			
+50	10°15′			
6	11°30′			
7	14°0′			
8	16°30′			
P. T. + 25	17°7½′	34°15′	N 18° 0′ E	N 17¾° E

The column of deflections contains the deflection angles computed from *P.C.* as far as convenient, say to station 135, and the stakes set and centered. For some reason 135+50 becomes necessary and has to be put in. Then the transit is turned back to 0° and turned over on the back sight to be sure that nothing has slipped, carried up to 135+50, and set up. The instrument is then set at 0° and sighted at *P. C.*, and then if turned to 10° 15′ it would be on the tangent at 135+50, and if turned to 11° 30′, it will be on the chord from 135+50 to 136, and by adding these 2° 30′ for each hundred feet the curve is run to 138 and the transit is moved to that place after taking a back sight as before, with the plates at 0°. After setting up at 138, if we could see *P. C.* we should set at 0° again, and turning to 16° 30′ we would be on the tangent; but *P. C.* is supposed invisible, and we shall therefore set the instrument at 10° 15′ and sight it back at 135+50 and the result is that the lower plate is in the same position as if *P. C.* had been visible, and we had as above suggested, set 0° and sighted thereat; by turning to 16° 30′ we shall be on the tangent at 130 and if we find that 1° 20′ more will be needed to strike the desired direction from there, we will put 1° 15′ more in the curve or 37½′ deflection which corresponds to 25 ft: we run out the 25 ft. and turn to 17° 6¼′ and sight the stake in, and then, turning to 10° 15′, we turn over to the back sight. After satisfying ourselves that it is all right, we go to 138+25 and being sure the instrument reads 10° 15, we sight again at 135+50 and turn to 17° 7½′ and are on the tangent. By taking the differences and comparing distances it will easily be seen that the angles are all right.

Now in what does this method consist that is better than the practice of counting stations and multiplying by the deflection angle? Only this, that the counting and multiplication are both performed already. Each station is attached to the angle opposite to it in the note book, and once there, it is good for all the work that you can do with it. The mental labor thus saved is a great help. It was once our fortune to have to "break in" two "green" transitmen in 5 weeks, and in all that time we computed every angle that was used at the instrument, mentally, and kept at the head of the chain most of the time; by asking the man at the instrument what reading he had and what station he was at and what his back rodman was at, we never let a mistake pass our notice. (*Note.*—We are not anxious to repeat this experience of transit running from the head of the chain.)

For the transitman himself, this system of notes is a great relief as he is free from the constantly recurring question "what is your next deflection?" with its importunate worrying when he has just set up on an odd "plus" and knows that his back rodman is also on an odd "plus" he simply asks himself, what are the readings for these two stations, knowing that the difference between them has been computed carefully once, as they come along and it will be all right now.

Unjointing Cast-Iron Pipe.

GALVESTON, Tex., Sept. 11, 1888.

EDITOR ENGINEERING NEWS:

Can you give me the address of some firm manufacturing machine and bands for unjointing cast-iron water pipe, viz.; for melting lead joints?

Yours Respectfully,

H. M.

[We have been unable to find a dealer handling a machine of this description. Inquiry at the Department of Public Works revealed the fact that semi-circular iron bands arranged so as to be kept heated by burning oil or alcohol had been tried. This device was not successful owing to the cracking of the pipes due to uneven heating. In New York there appears to be but two general methods pursued: one is to chip the lead out, and the other is, in case of "dead" pipes, to build a wood fire under the joint.—ED. ENG. NEWS.]

Status of Work on the Manchester and Corinth Ship Canals.

CHICAGO, Ill., Sept. 4, 1888.

EDITOR ENGINEERING NEWS:—

I send you herewith plan and profile of the Manchester Canal and profile of the Corinth Canal, obtained on a recent trip of inspection of both canals There is not much that will be new to tell of either, but a few notes, may possibly, be of interest.

The contractors' plant on the Manchester Canal is something astonishing. Mr. THOS. A. WALKER has the contract for the canal complete, including the docks at Manchester, Eastham, etc., for the lump sum of £5,750,000 sterling. His manager, Mr. W. H. TOPHAM, very kindly took me over a large part of the work. He has now, or will very soon have at work, 150 standard gauge locomotives, 70 steam shovels, 5,000 dump cars and 15,000 men. The number of men is small in proportion to the amount of work being done, as nearly all the material is handled by machinery. The thing particularly noticeable about the Manchester work is the very complete and full preparation for everything and the perfect system running through it all. The contract time for the work is 4 years from the first of last January, or by the end of 1892, and it seems as though the whole must be done with scarcely a hitch or jar from start to finish. Everything seems to have been thought of and provided for, from the system of book-keeping to the smallest detail of camp arrangement. American contractors might do the work with less expense for outfit and with less red tape and machinery of management and superintendency, and probably would do the work for less money, but it seems absolutely certain that Mr. WALKER'S contract will be carried out according to agreement. The latest facts as to the status of the work may be summarized thus:

SECTION I.—EASTHAM TO ELLESMERE PORT.

The cutting on this section has now got down to the third lift, which is very hard and requires blasting. Although so deep, the cutting is comparatively free from water. The accompanying view, which appears in the *Lancashire Merchant and Ship Canal News*, a little journal chiefly devoted to the news of the canal, is taken from this section at the eastern end of the first and principal cutting, and shows where the canal will run across the foreshore for over half a mile, when it again enters the land. The cutting at this point will shortly be joined to the large cutting of rock near Ellesmere Port, when the whole work rom Eastham to Ellesmere Port will be connected.

SECTION II.—ELLESMERE PORT TO INCE.

The cuttings on this section are rapidly advancing, and great progress is shown throughout the section.

SECTION III.—INCE TO WESTON POINT.

Work here also is proceeding rapidly, nearly the whole of the land between the Powder Magazine and the River Weaver being stripped ready for excavating. The Wilson' steam navvy is now at work, and as the soil is of a soft nature, it is expected to make great progress. Thirty-five huts have been commenced here for the navvies which are expected to be soon ready for use, making a total of 44. The water here is rather troublesome, and a steam pump has been erected.

SECTIONS IV, V AND VI. WESTON POINT TO WARBURTON.

The work is being kept steadily going, but there is nothing on them of especial interest.

SECTION VII.—WARBURTON TO BARTON.

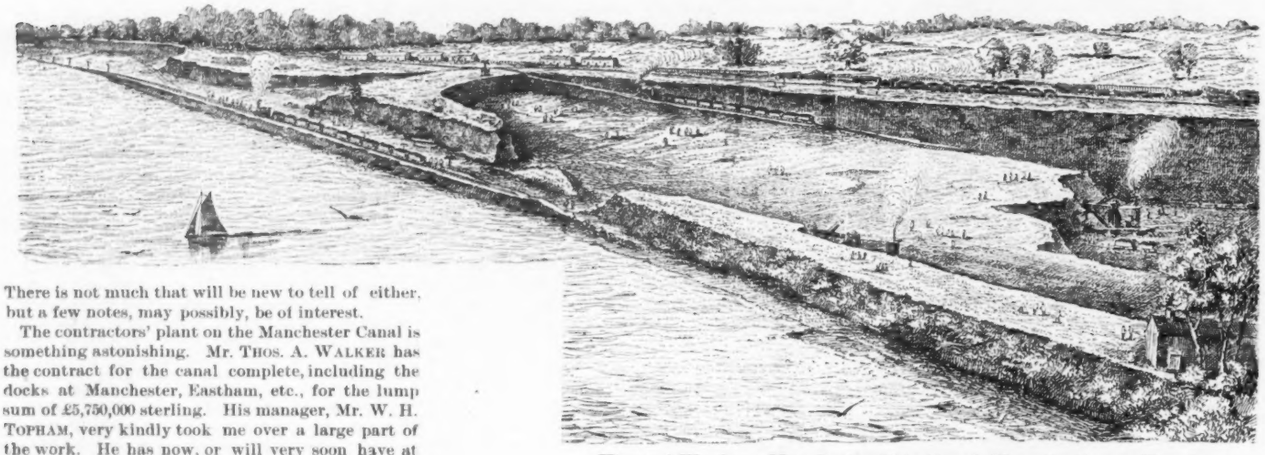
A new cutting has been commenced between Bottom Farm, Calishead, and the Cheshire Lines Railway, and is stripped ready for the steam navvy which is being erected on the other side of the river.

SECTION VIII.—BARTON TO MANCHESTER.

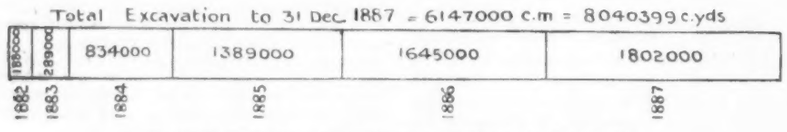
A landslip recently took place near Barton Bridge, and has had to be filled in with stone to prevent any more slips, which will form part of the embankment. The boundary wall has been commenced at Barton Bridge and midway between Trafford Bridge and Barton Bridge the stone from the Eccles sub-section being used for the building. Another cutting has also been commenced at Mode Wheel.

The Chief Engineer of the Corinth Canal is Herr KAPP, a cosmopolitan German. He seems to have something of the Yankee in his way of working things and his facility in adapting means to ends. The work at Corinth is in excellent shape and will undoubtedly be completed within two years from now. Herr KAPP told me that by Aug. 1, 1889, the excavation would be completed 2 meters below sea level for the entire length of the canal. Instead of the excavation being solid granite, there is no granite on the line of the canal, nor in all Greece. There is very little hard rock to be excavated. At the western end of the canal there is a small quantity of conglomerate which is troublesome to drill but which blasts well, and beside that there is nothing harder than a soft chalky rock more like a very dry indurated clay, or hard Mexican *tepetate* [We have often explained the nature of this material, which is so abundant in Mexico. ED.] than anything else that can be compared to it. It does not have to be drilled, but can be bored with long augers: and after being shaken up with dynamite is easily broken and handled with picks and shovels. A large part of the excavation at Corinth has been done by driving tunnels a mile or a mile and a half long, from 45 to 60 ft. below the surface. Shafts 4 or 5 ft. in diameter and about 100 ft. apart are then sunk from the surface until they intersect these tunnels. Long trains of dump cars are run into the tunnel and the material, which is dry and crumbles easily, is then tumbled down through these shafts into the cars. Tunneling is not expensive in this material, and the plan works well. When the material above one tunnel is nearly all removed, another tunnel is driven 50 or 60 ft. below the first and so on until sea level is reached. I have never seen this method followed before to anything like the same extent, and it was to me very interesting.

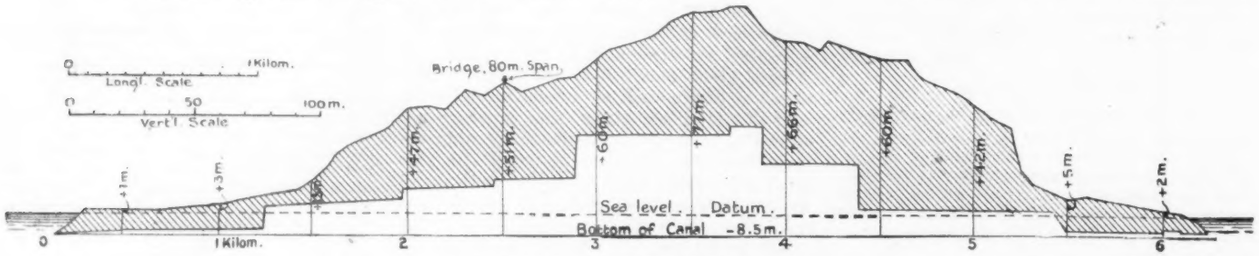
The force employed on the Corinth Canal is much smaller than on the Manchester. They are using now 13 thirty-ton locomotives, about 700 dump cars of 3 cu. m. capacity each, and have 1500 men employed. Their greatest days work has been 8000 cu. m. They are removing now from 160,000 to 180,000 cu. m. every month. There seems to be no difficulty in the way of the completion of the canal within two years at farthest. Herr KAPP, the Chief Engineer, is now making experiments with a view to changing the angle of the slopes. As originally laid out they were ½ to 1. He is proposing to flatten them considerably. The change will increase the quantities from about 8,000,000 cu. m. as they are with the present slopes, to 10,500,000 cu. m. The surface width will be increased 6 m. and the bottom reduced correspondingly by 6 m. leaving the total water cross-



View of Work on Manchester Ship Canal, Near the Lower Terminus at Eastham, Looking up the River.



Corinth Ship Canal. Progress of Work in Each Year.

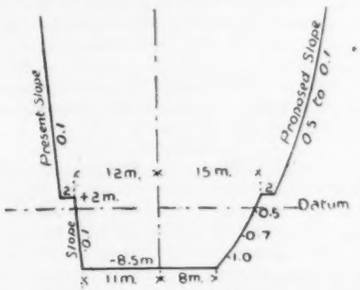


Profile of the Corinth Ship Canal.

Showing status of the work Dec. 31, 1887, the part hatched being the completed work.

section unchanged. But the slopes will not be cut off unless and until the present side slopes prove unstable.

Among engineers abroad, the almost universal opinion is that the Panama Canal will not be finished by the present company; but it seems to be



Corinth Canal—Proposed New and Old Sections.

thought that possibly some new company may acquire the works for a nominal sum and eventually finish the canal. I did not find anywhere in Europe an engineer who believed the Panama Canal would be finished by the present company. Most of them thought it would never be finished. On the contrary all of the opinions which I heard expressed with regard to the Nicaragua Canal were wholly favorable.

Yours truly
C. P. T.

[We illustrated and described the work on the Corinth canal very fully, showing maps, profiles, methods of work, etc. etc., in our issue of June 7, 1884, and in June and July of this year gave a very full abstract of the status of work on the Manchester canal, all of which matter can be examined with interest in connection with the above letter.—ED. ENG. NEWS.]

The Memphis Artesian Water Supply Again.

CINCINNATI, O., Sept. 24, 1888.

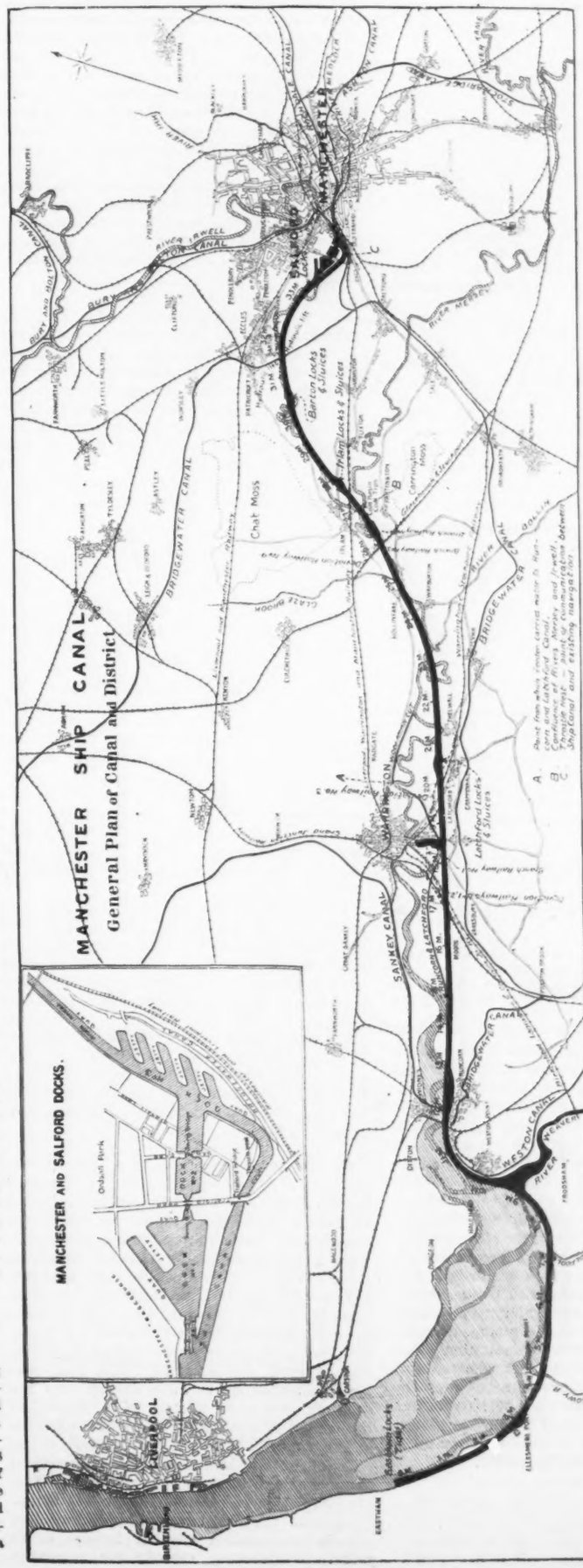
EDITOR ENGINEERING NEWS:

In your issue of the 22nd. inst., page 236, the Cook Well Co. puts in altogether too broad a claim. As to the furiousness of the thunder and lightning with which said company threatens you we leave you to judge. But here is about the depth and breadth and blackness of the dread cloud hanging over your luckless heads.

The Cook Well Company says: "Several well companies are claiming in various magazines the credit for supplying the Memphis Artesian Water Co. with water, but such claims are entirely false, and a great injustice to us." A Mr. Cook did sink twelve wells for the Artesian Water Co. of Memphis. But the National Water Supply Co. of Cincinnati sank not less than *sixteen* wells for said Artesian Water Company, and several more for the Memphis Water Company, which afterwards was united with the Artesian Water Company. As to what other Companies than the Cook may have "claimed in various magazines" we know nothing. But certain it is that the Cook Company's claim is "false" to the degree indicated by the above statement, "and a great injustice to us." But we don't propose to harm, or even threaten you, if you give the Cook Company due credit for the good work which one Mr. Cook did toward procuring for the City of Memphis one of the very best water supplies enjoyed by any city on either continent.

Very Respectfully,
The NATIONAL WATER SUPPLY CO

IRON VS. STEEL IN SHIPBUILDING.—It is interesting to note the effect of the comparatively recent introduction of cheap steel plates in shipbuilding, and the fact that this metal is rapidly replacing iron. In the annual report of the British Iron Trade Association a table is given which shows that in 1878 only 7 steel ships were launched, with a tonnage of 4,470 tons, as opposed to 435 iron ships in the same year with 517,692 tons. In 1887, however, 391 steel ships were built, with 465,792 aggregate tons, as contrasted with an unknown number of iron ships of a total of 111,535 tons.


MANCHESTER SHIP CANAL
General Plan of Canal and District.
MANCHESTER AND SALFORD DOCKS.
LIVERPOOL
MANCHESTER
SALFORD
BRIDGEWATER CANAL
SANKEY CANAL
WESTON CANAL
RIVER MERSEY
RIVER IRWELL
Barton Locks & Sluices
Irlam Locks & Sluices
Latchford Locks & Sluices
Chat Moss
Carrington Moss
Plan from which similar carried water to Manchester, Salford and Irwell
Proposed new line of communication between Ship Canal and existing navigation
Plan and Profile of the Manchester Ship Canal.
In the estuary of the Mersey River, at Liverpool, the dark hatched area gives that flooded at low water, and the light hatched that flooded at high water. Side entrances, with gates, from the estuary into the canal, will be provided where required. The high-water level of the canal profile is that of ordinary spring tides, and the lower line that of neap tides.

ENGINEERING NEWS

AMERICAN RAILWAY JOURNAL.

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D. McN. STAUFFER, A. M. WELLINGTON.
EDITORS.
GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year; $2.50 for Six Months; $1.50 for Three Months; Single Copies, 12 cents.* FOREIGN COUNTRIES, $6.50 *per Year, or 3 cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Kansas City, Mo.—Regular meeting, Oct. 1. "The Complete Sewerage of Kansas City." Secy., Kenneth Allen, Y. M. C. A. Building.

Civil Engineers' Society of St. Paul, Minn.—Regular meeting Oct. 1. Secy., Geo. L. Wilson, City Hall.

American Institute of Mining Engineers.—Next meeting at Buffalo, N. Y.; beginning Oct. 2. Secy., R. W. Raymond, 13 Burling Slip, New York.

American Society of Civil Engineers, New York.—Regular meeting, Oct. 3. Secy., John Bogart, 127 E. 23d St.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland, O.—Regular meeting Oct 9. Report on Civil Engineering. Secy., James Ritchie, Care Library Rooms.

American Society of Mechanical Engineers.—Convention and annual meeting at Scranton, Pa.; beginning Oct. 16. Secy., F. R. Hutton, 280 Broadway, New York.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Oct. 16. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Oct 17. Secy., S. E. Tinkham, City Hall.

American Street Railway Association.—Next meeting at Washington, D. C.; Oct. 17. Secy., W. J. Richardson, Brooklyn, N. Y.

THE Elevated has had another lucky escape from what might have been a very serious accident. An oblique head collision caused a car, loaded with passengers to almost fall into the street, being restrained chiefly by a switch-post. Had it done so, there could hardly have failed to be considerable loss of life, and very possibly other cars would have been dragged off likewise. We do not see that the accident can be charged in any way to defects of administration. The operation of the elevated road seems to be about as careful as it can be made. But there are dangers which are inseparable from overcrowding tracks with trains, which no care can eliminate, and which may yet give New York a terrible lesson by some disaster which will shock the whole community. The same is true of the Brooklyn bridge, and there with far less excuse of necessity. On the elevated, there seems no remedy either for overcrowding or a good deal of switching, except the radical one of building more lines to accommodate the growing traffic.

A danger to which both the Brooklyn bridge and the elevated are subject, from which both have as yet fortunately escaped, is that some sudden panic—a pistol shot, a sudden quarrel, a drunken row, or even no real cause at all—may start a rush on a crowded platform which will throw a score or two of passengers off of it and on to the track in front of an approaching train, when the slaughter might be frightful. Only one of the elevated stations is ordinarily so crowded as to be in much danger from this cause, that at Chatham Square, which badly needs radical enlargement, but both termini of the Brooklyn bridge are in still worse status—a status which is the less excusable because the present state of things is a constant source of annoyance and discomfort to every passenger, and hence should be remedied apart from the danger.

AQUEDUCTS seem to run to crookedness. An aqueduct scandal of possibly enormous proportions has just developed in Washington. Precisely the same thing appears to have been done as on the New Croton Aqueduct, viz., enormous voids have been left concealed behind the lining which were supposed to have been filled with masonry, and it is stated by Lieut. TOWNSEND, U. S. Engrs., the engineer officer in charge, that hardly one-fifth of the proper amount of cement appears to have been used.

THE great disaster in Valparaiso again illustrates the irremediable objection to earth dams, that they cannot be made absolutely secure against danger of leakage, and when they go out, go out all at once, perhaps from the effect of a small and unsuspected subterranean leak, which begins suddenly to enlarge. Such dams are only suitable therefore for pastoral localities where cheapness is essential, and permanency not so absolutely essential as where the lives and water supply of a large population are dependent upon it. The same difficulty of making earthen embankments of any kind absolutely secure against water has been illustrated again and again in canal work, the most carefully built canal embankments, which have stood for years uninjured, giving way at times suddenly and completely.

In the meantime we have received and shall shortly reproduce photographs and drawings of one of the high rock fill Arizona dams described by Mr. JAS. D. SCHUYLER in our issue of two weeks since, which are stated by him to be even cheaper than earth fill dams, as they certainly are more permanent. They would seem to have all the advantages of earth dams with all the durability of masonry dams, and more than their immunity from sudden failure. We cannot doubt that the type will become increasingly common, especially for high dams.

IN the interesting history of the Denver Water-Works new supply, given in this issue by Mr. FORTIER, is a note of more than passing interest in connection with the suppression of the growth of vegetable matter in reservoirs. The Chief Engineer, Mr. ALLEN, found, as others have found before him, that close paving over the bottom of the reservoir rather increased than diminished the objectionable growth. He then decided to cover his reservoir, and for financial reasons adopted a cheap but effective wooden roof. This roof was under construction in June during very hot weather, and while a strip 44 ft. wide over the center of the basin was still uncovered and that much of the water yet exposed to the effect of sunlight and heat, algæ commenced to appear there in 12 to 14 ft. of water. With the completion of the roof the growth disappeared, and the algæ have not appeared since, though last summer was the hottest in 10 years. This roofing remedy for vegetable growth has been advanced before and its efficacy denied. But the experience of Mr. ALLEN would seem to prove conclusively that the sunlight is responsible for the mischief, and that its exclusion will put a stop to the trouble. The permanent roofing of large reservoirs is an expensive operation in first cost; but the annual cleaning of a large reservoir of vegetable matter also represents the interest on a sum that might pay for a roof or efficient covering, to say nothing of the annoyance and danger to water consumers who are compelled for a time to use bad water.

IN view of the fact that vigorous efforts are again being made to secure action by Congress on the bill to charter the Nicaragua Canal Company, it might be well to remark that the objectors to this bill are either unpatriotic fools, or they are knaves in the service of a foreign canal enterprise. This bill does not ask Congress to appropriate a dollar of money, to guarantee any interest, or to involve itself in any way financially with the future of the canal. But it does ask national recognition and the means of maintaining its rights outside of American territory. The Nicaragua Canal will be a waterway primarily connecting important parts of our country; and while it will without doubt be open to the commerce of the world, it should be first and last an American enterprise, built by American engineers with American money and always controlled by the American Government. The fact that we will need a powerful American navy to maintain our rights, in this and other directions, should be an incentive to hasten the re-creation of that navy as speedily as possible. The country wants no more CLAYTON-BULWER surrenders, Mosquito Protectorates, or KINNEY or WALKER fiascos. But our Congress should obey the real wishes of the people in this matter and proclaim our intentions and assert our rights in a manner that cannot be mistaken; delay secured by Panama intrigue is not only disgraceful but it is dangerous in encouraging other nations to foster an enterprise that the United States alone should control.

WHILE it might not be exactly consistent with the terms of the existing CLAYTON-BULWER treaty, the control of Lake Nicaragua by the United States would be particularly important and desirable either in war or in peace. With both ends of the canal in the hands of our Government one fleet on the lake would be worth two fleets separated by a continent; it could sally in either direction as need might call. And in time of peace this enormous body of fresh water would be a naval station unparalleled for its convenience to either coast of our country. Of course, such a use of these waters would require a treaty with the Central American States somewhat like the one presented by General GRANT some years ago, in which this country was ceded absolute control over a certain strip of territory, with the right to erect fortifications, etc.

THE Supreme Court of Minnesota has just rendered decision upon two very important cases. In the first, the Minneapolis & St. Louis Railway Company and the Railway Transfer Company of Minneapolis appealed from the ruling of the State Railway Commission that maximum switching charges for transferring cars over the latter company's railway should be $1 per car. In his opinion Judge Dickinson says:

"The question is whether the statute creating the commission and prescribing its duties authorizes an appeal to the district court from an order of that body prescribing rates to be charged by a common carrier. * * * * The statute clearly expresses the intention of the legislature

that the action should be final and conclusive. It declares the authority of the commission to prescribe rates and its power to compel common carriers to adopt the rates which it shall declare equal and reasonable."

In the second case a mandamus proceeding was involved by which the Minneapolis & St. Louis, and the St. Paul, Minneapolis & Manitoba companies are compelled to bridge their tracks where they cross streets at grade in the city of Minneapolis. The decision affirmed the legality of the proceedings by which the construction of these bridges was imposed upon the company affirming that, "the fact that a railroad has once been lawfully constructed upon the grade of a street does not exempt it from bridging when that becomes necessary."

It is sincerely to be hoped that this decision will have no influence in establishing precedents for decisions in other States. If railroad commissions as at present constituted can, by fixing such traffic rates as they choose, limit the income of railway companies, and if City Councils and Legislatures can saddle upon the railways the whole expense for whatever improvement or changes they consider necessary, the dividends for the owners of the roads seem to be at the mercy of men not too noted for uprightness and breadth of view. We heartily second the movement toward the abolition of grade-crossings; but the placing of the whole burden of expense for their removal upon the railway companies would in most cases be iniquitous.

The Best Method of Keeping Field Notes of Curves.

There is no new thing under the sun, said the prophet, and it is no great surprise to us to find, as we do by a communication in another column, that the method of keeping field-notes of curves suggested as probably new by Mr. ROBERT BURGESS, Asst. Chief Engineer of the Kansas City, E. P. & M. R. R., and which we endorsed as such and as the best in use by far in a note to his letter, is in fact almost as old as the railway in the knowledge of a few, and was published in our own columns twelve years ago, in some very practical articles written for this then infant journal by the late Prof. CHARLES A. SMITH.

New or old, however, it is thoroughly good, and ought to have been in every field book published since CROSS, instead of in none of them. We advise every reader interested in any way in railway field-work, either for himself or for those under him or over him, to turn to the communications in this and our last issue, and do what he can to establish this decidedly preferable system of keeping notes of curves as the standard. "It will frae monie a blunder free us, and foolish notion" of young transitmen puzzling over their notes of odd deflections for odd stations of odd curves, and in not a few instances, we can testify, blotting them with at least an inward tear of mortified annoyance.

That anything new and likewise valuable in so simple an art as that of running in circular curves should turn up at this late day, is certainly surprising, and naturally suggests a backward glance over the field-books of the past, and their methods and character in this and other respects. These facts, as to the field-books which are at all well known, may be summarized as follows:

The first field-book ever published was the "Railroad Manual", of Col. S. H. LONG, U.S.A. which was published in 1829—an extraordinary evidence of how early the railway movement set in in this country, since it was in October of that year that the trial of the Rocket took place, in which event the modern railway system really had its birth. Long prior to that, however, in 1761*, the first circular arc had been run by modern deflection methods, viz. the curve of 12 miles radius (0° 5′ 426″ curve) from Newcastle Court House, so called, as a center, which constitutes the northerly boundary of the State of Delaware, extending in all for a distance of 25 miles, or over an arc of some 121°, and leaving a thin triangular wedge of Pennsylvania extending down for 2 or 3 miles between the curve and the east line of Maryland. This curve was very accurately run, and was revised two years later by the famous MASON and DIXON as a preliminary to running the boundary between Pennsylvania and Maryland, which also had been run before, and as it proved, with great accuracy.

The precise manner of keeping the notes for this boundary curve, we may be sure, was not a matter of much study, nor do we presume that any particular mode was laid down either in Col. LONG's field-book, or in the one next to follow it, that of SAMUEL W. MIFFLIN on "Railway Curves" published in 1837. Both these works, however, antedated Prof. RANKINE's great treatise on "Civil Engineering" which first appeared in 1843, although in it Prof. RANKINE claimed the method as new and as his own, stating also that he had used it in 1841.

The next field-book, and the oldest one which still remains in use, was Mr. J. C. TRAUTWINE's "Field Practice of Laying Out Circular Curves for Railroads" published in 1851, which had a good sale for many years but had almost passed out of use in favor of HENCK's field-book when Mr. TRAUTWINE's great "Engineers' Pocket Book" appeared, and naturally revived the sale of his earlier work, which he soon revised and greatly enlarged. In this book also a specific form of keeping notes is not laid down, but by implication the same method as that taught in HENCK is distinctly specified. The work had the defect of being not very systematic in its arrangement or clear in its demonstrations, while some of the methods taught were unnecessarily loose, and hence it was only for the few years prior to the publication of HENCK's field-book that it was regarded as the standard.

Following TRAUTWINE there appeared almost simultaneously the still standard "Field-Book for Railroad Engineers" by JOHN B. HENCK (1854) and the "Engineers' Field-Book" by C. S. CROSS (1855). Which was the earlier written we do not know. CROSS's field-book was a thin little volume, the most appreciated feature in which was a table of the length of tangents for a 1° curve for each minute of central angle; but it likewise contained the first specific form of keeping curve notes which was ever published, and the first one in which the proper system of keeping the notes was laid down;—a system which it now appears has found scattered recognition in the practice of individual engineers, but which has been entirely ignored by all other and later field-books in favor of much inferior methods, and hence is not generally known at all. There being some demand for this book, which has for over 20 years been out of print, it was reprinted and is still for sale by this journal.

HENCK's admirable treatise was for its day a great advance; and even to this day, it is in form and method distinctly superior to any other before the public, striking a most judicious mean between making a field-book a collection of "barren mathematical exercises" and "a collection of mere rules, professing to require only an ability to read for their successful application". Since its publication, however, practice has greatly changed and advanced, while much that was contained in HENCK was not the practice even of his day, but was evolved from his inner consciousness as to what might, could, would or should be done. It is therefore no longer really suitable for modern use, but its excellence of form and method has given it, even to-day, probably a larger sale than any other field-book. Among the specific parts to which the specified objections may be taken are almost the entire chapters on computation of earthwork, frogs and switches, parabolic curves, reversed curves and in a large degree compound curves, while the young student can get little idea from the book as to how any part of the field-work is done in practice.

HENCK, on the other hand, was the first to introduce the modern system of keeping level notes, by height of instrument, which replaced an incredibly awkward and cumbersome system, still in use to some extent abroad; and in vertical curves and many other details he introduced great improvements of method. His system of keeping field notes of curves, however, is distinctly to have the vernier read zero when the instrument is on tangent, not only at the P. C. but at any and all intermediates, and only those who have "run transit" in their early experience, and had a level party sitting on the rocks behind them and making gentle remarks about the "*sic transit*" party while they were getting puzzled more and more over a multitude of computations for numerous transit points, can appreciate how awkward the method is.

After HENCK and CROSS no field book appeared to dispute the field for a quarter of a century. The only exception we recall was a wretched little compendium of "mere rules" called GRISWOLD'S "Pocket Companion for the Field", which never attained any considerable prominence. But in 1879 and 1880 there appeared almost simultaneously Mr. WM. F. SHUNK's "Field Engineer" and Mr. WM. H. SEARLES, "Field Engineering", both of which were prepared with more elaboration than any previous volume to fill an undoubted void in engineering literature, and both of which, as a consequence, have enjoyed a considerable sale.

These books we reviewed together, with some elaboration, in our issues of Dec. 4 and 11, 1880, and we have seen no reason to modify any of the views in regard to them we then expressed. Both have real merits, but Mr. SEARLES' book is, to a quite unpardonable extent, a collection of "barren mathematical exercises", going far beyond HENCK in that respect, and containing a multitude of hair-splitting refinements which no one ever has used or ever will use in practice, and which greatly increase the size of the volume to no purpose whatever, or rather, to worse than no purpose, because they confuse and discourage the student, and by destroying his mental perspective, decrease his chance of acquiring a sound knowledge of what is really important.

We therefore, as we stated in our former review, regard SHUNK's field-book as on the whole the best single book to have in one's pocket in the field, although both SEARLES and HENCK have merits which SHUNK lacks. It is perhaps no slight evidence of the justice of this criticism, that SHUNK gives the next best system of keeping field-notes of curves to that of CROSS, while SEARLES teaches with greater fulness the same method of keeping notes as HENCK, in the following words:

"In beginning a curve the transit being set at the P. C., zeros together, the reading of the limb for any station on the curve has simply to be made equal to the proper deflection for the tangent for that station. After the transit is moved forward from the P. C. and set at another point of the curve, the vernier is set to a reading

*The date of this event is misprinted in Trautwine's "Field Practice of Laying Out Circular Curves" (note to preface) as 1701.

equal to the reading used to establish that point, *but on the opposite side of the zero*, (italics as quoted) and the line of collimation is set on the P. C. just left. Then, by simply turning the zeros together again, the line of collimation will be made to coincide with a tangent to the curve through the new point, and the deflections for the succeeding stations can be read off directly, as before. Thus any number of transit points may be used in locating a curve, by finding the direction of the tangent through each by a deflection from the preceding point, until finally the P. T. is reached, where another deflection gives the direction of the located tangent."

This reads very simply on paper, but in practice it is anything but simple, nor is it possible under it to follow the next injunction that "the assistant engineer keeps neat and systematic field-notes of all his operations with the transit in running curves." On the contrary, a good deal of change and erasure of previous notes is almost inevitable, and the only check on the work after leaving the P. C. is to go into quite a considerable calculation, for which, at the very time that the transitman is most in need of it, there is usually scant time.

Compared with this, the method taught in SHUNK is much to be preferred. Under it, after deflecting from the P. C. for as many stations as can be seen from it, the transit is moved ahead and sighted on the back sight with the vernier unchanged; tangent is obtained by doubling the previous angle, and deflections for further stations by adding their successive deflection angles, so that the zero of the lower limb is throughout parallel with the tangent at the P. C., and the vernier always reads the total deflections from the P. C., the last reading, in turning into tangent at the P. T., being the total central angle of the curve. One great advantage of this method is that it makes it easy to check by the needle at any point, while the field-notes are also simpler than by the HENCK-SEARLES method.

But the best method of all is that which was first taught by CROSS in 1855, and revived in these columns by Prof. CHAS. A. SMITH in 1876, (Aug. 26) and again last week, but which has been known heretofore to a few individuals only for lack of endorsement by and presentation in the more commonly used field-books. The difference is no slight matter in practical field-work, and we are confident that by the present readers of ENGINEERING NEWS no other method will hereafter be used or taught.

The Railways Terminating in London.

The most interesting and the most instructive feature by far of the English railway system to an American is their vast and costly system of terminals. Not only in London, nor even in the other great "terminal" cities properly so called, but also in almost every town of over 100,000 inhabitants, immense sums have been expended in getting station buildings in the very heart of the town, and in getting the lines to and from them either over or under the grade of the streets so that practically the two are independent of each other. It is in this detail that our American railway system is most deficient; it is for this, consequently, that a large part of the construction expenditure of the next 20 years must be made, and hence it is work which is not only interesting in itself to study, but is likely to become of great value as precedents for American practice.

Mr. REA* has therefore done a service which we think will be appreciated in collecting together in convenient form the more salient facts in regard to the great London terminal system, a work which his experience as an engineer and operating officer in the service of the Pennsylvania Railroad Co. well qualifies him to render. It would hardly become us, as the publishers of the work, to enter into any extended review of its merits and demerits, but we may appropriately avail ourselves of the information contained in it as to the remarkable system which has grown up in and about London, which throws far in the shade anything we have as yet in this country.

The following comparative tables, which we abstract from two given by Mr. REA, show the increase in railway mileage, capital and traffic from 1875 to 1886, or 11 years:

1875	Miles	Capital 1=$1,000,000.	Receipts, 1 = $1,000. Pass.	Fr't.	Capital per mile.
12 London lines	7374	1631.64	82.23	87.53	$221,000
Other English lines	4415	1003.82	26.89	52.21	227,000
Scotland	2721	364.43	12.30	20.58	134,000
Ireland	2148	151.23	7.75	6.02	71,000
Total Un. Kingdom	16658	3151.12	128.57	166.34	$189,000
1886					
12 London lines	9321	2285.86	102.72	103.73	$246,000
Other English lines	4357	1153.99	26.13	50.36	265,000
Scotland	3022	522.88	14.96	21.41	173,000
Ireland	2632	179.89	7.41	6.35	68,400
Total Un. Kingdom	19332	4141.72	151.22	181.85	$214,000
Increase, 11 years.					
12 London lines	1947	654.22	20.49	16.20	346,000
Other English lines	—58	149.17	—0.76	—1.85	
Scotland	301	158.55	2.66	0.83	528,000
Ireland	484	28.66	0.36	0.33	58,400
Total Un. Kingdom	2674	990.60	22.65	15.51	371,000

In considering this table, it is to be remembered that, apart from the improved styles of terminals and other improvements of that nature, the cost of English railways per mile has been decidedly lower since 1875 than what it was before that time. Extortionate right of way charges to propitiate influential and conscienceless land owners are no longer the rule. Cuts and fills 6 or 8 miles long, and no curves sharper than of 1 mile radius, are luxuries no longer indulged in to any large extent. Iron and steel are largely used instead of great masonry structures, with large economy. Above all, the main trunk lines were built long ago, and the modest increase of 2,674 miles since 1875 is to a very large extent cheap branch lines, many of which have not cost over $60,000 or $80,000 per mile, which is very cheap for England.

Again, the nominal capital account represents for the most part actual cash paid in and expended, and not, as with us, large amounts of water. Bearing these facts in mind, the contrast in these tables is certainly significant.

In Ireland, the newer railways have cost considerably less than the old ones, and the capital per mile is lower than it was 10 or 15 years ago, as was to be expected from the fact that the cheaper new construction has not been swamped by large betterment expenditures. But in England and Scotland the contrast is tremendous.

Thus the Scotch mileage has increased but very slightly, 301 miles, and that, we may be sure, mostly cheap road. If we were to estimate it at $100,000 per mile, apart from modern terminal works or say $30,000,000 in all for new mileage, we should be making a liberal estimate. But the capital account has increased by $158,550,000, leaving fully $128,000,000 as expended for betterments, and of this at least a full half has been for strictly terminal expenses.

In England, the 9 railway systems centering in London, neglecting the 3 local lines whose mileage of 55 miles is all in the metropolis, have obtained by absorption a largely increased share of the total English mileage, or 9266 miles in 1886 against 7341 in 1875. This naturally implies some increase of capital for new mileage, but how small a part this is in the total enormous increase of $654,220,000 in capital may be shown thus:

	Mileage.		Capital. 1 = $1,000,000.		Capital p. mile.	
	1886	1875	1886	1875	1886	1875
3 Metropolitan	55	53	119.19	86.75	$2,167,000	$2,628,000
9 Other lines.	9266	7341	2166 67	1544.89	$234,000	$210,500
Total of 12 lines.	9,321	7374	2285.86	1631.64	$246,000	$221,000

The increase of 1,925 miles in the 9 trunk lines has certainly not cost over $150,000 per mile, or $288,750,000 in all. It is more than probable that its cost was not much over $200,000,000. But the total increase of capital of these trunk lines was $621,780,000 and this is almost all of it for hard cash expended. This leaves at least $333,000,000, and probably at least $400,000,000 which has been expended in betterments on these nine lines alone, an addition of nearly 25 per cent. to their enormous original capital, of which far more than half, and probably fully three-fourths, has gone into terminal improvements. In addition to this vast sum, there has been expended on the internal London railways no less than $32,440,000, which we may throw out of account as wholly for new construction, although it was the result of the same necessity, to have better means of access to the heart of great cities.

Where these vast sums have gone, and why it has been necessary to spend them, becomes very apparent by a study of the maps and statistics presented in Mr. REA's volume, which we cannot now attempt to fully summarize. For one thing, every one of the great trunk lines has been carried into the very heart of London, in direct connection with the inner circuit of the Metropolitan underground railway and hence with each other. The cost of securing such close connection, which is largely by high viaducts, has been enormous. Eleven great terminal stations have been erected on this inner circuit to accommodate these nine lines, besides two for the local lines.

For another thing, by a striking contrast from our American custom, each one of these lines has built large and costly modern hotels, and one of them two such hotels, in immediate connection with their termini. It is at first sight hard to explain why there should be such an opposite tendency abroad and here, for the tendency is not confined to London, nor even to England. In Liverpool, Glasgow, and several other large English towns, there are similar railway hotels, while they also occur in several cities on the Continent. On the other hand, in this country, there is not a single instance of it. There was one on a small scale in Pittsburg, in a hotel-station belonging to the Pennsylvania Railroad which was burned in the great Pittsburg riots; but the various sea-side and summer resort hotels which have been built by various railways, chiefly on the Pacific coast, do not belong to the same category at all.

We take it that the true explanation is the enormous cost of land on which these railway terminals are placed, which makes the companies desirous of devising some revenue from the ground, which they can do at the same time that they are accommodating traffic by erecting hotels. Probably the same tendency will become visible in time in this country. The cost of some of these terminals has been almost fabulous, and the companies may well have felt that there was "room

*The Railways Terminating in London, with a Description of the Terminal Stations and the Underground Railway. By SAMUEL REA, M. Am. Soc. C. E., Asst. to Second Vice-Prest. Pennsylvania R.R. New York: ENGINEERING NEWS Publishing Co. $2.

higher up", and that they could not afford to throw away the air space over such costly land. In part also, it may be due merely to an increasing demand for good hotel accommodation, which has not been met, as in this country, by private enterprise.

How great the increased demand is, is shown in part by the increase in annual passenger receipts shown above. We are in the habit of thinking of England as a finished country, and almost as one which may soon be going down hill. Perhaps relatively this is true, but that England is far from being on the down hill road as yet is apparent from the enormous growth in earnings shown above. It is perhaps significant, however, that it is almost wholly confined to the London lines, the other English lines showing even a falling off, while Scotland has increased but little (chiefly in passenger business) and poor Ireland scarcely at all.

The great increase in the traffic of the London railways, in recent years, is shown in a still more striking way by a table showing the growth in passenger traffic (number of passengers) for each 5 years since 1865. These are so interesting as to be worth making some computations from. Taking the passenger traffic of 1865, for each of the London lines, as 100, we have the following phenomenal increase:

	Relative No. of Passengers.				
	1865	1870	1875	1880	1885
Great Western	100.	136	206	253	286
London & N. W.	100.	128	189	203	231
Midland	100.	157	248	252	289
Great Northern	100.	142	261	312	376
North London	100.	221	228	309	317
Great Eastern	100.	105	268	386	519
Southeastern	100.	119	145	160	161
London C. & Dover	100.	166	223	311	300
London, B. & S. Coast	100.	132	173	246	237
London & S. W.	100.	126	198	285	326
Average	100.	143.2	213.9	271.7	304.2

This is a very remarkable rate of increase for quinquennial periods, even remembering that the mileage operated has likewise increased considerably. The area reached by these ten lines, and tributary to London, is not materially different, and these figures, therefore, express with tolerable correctness the relative traffic of that great metropolis, which has thus multiplied three-fold within 20 years. The details of this great change are well worth study.

The Sundry Civil Appropriation bill which passed Congress on Sept. 27, contains an item appropriating $100,000 for surveys for storage reservoirs on the western tributaries of the Mississippi for irrigation purposes.

Mr. Hawksley and the Vyrnwy Water-Works.

Later news than that contained in our last issue, concerning Mr. HAWKSLEY and the controversey over the value of his services as consulting engineer of the Liverpool water-works, shows that he claimed originally $300,000, and actually received in all $175,000 for these services. The original dispute arose from the fact that while Mr. HAWKSLEY was engaged to design and carry out the scheme, Mr. DEACON, the water engineer of Liverpool, was also actively engaged in the work. Mr. HAWKSLEY resented this interference, as he called it, and finally resigned his office several years ago. The present decision is only in payment for what he had done up to the time of his resignation; and as nearly all construction has been done since then, the services could practically only apply to features of design.

The amount involved seems very large when compared with the American practice in remunerating engineers. But as we understand the position of consulting engineers of Mr. HAWKSLEY'S standing, he was personally responsible to the extent of his fortune for the success of his plans; and any failure due to faulty engineering would have had to be made good by that gentleman personally, if possible.

PERSONAL.

GEORGE A. GRAVES, Superintendent of the Syracuse, Ontario & New York Railroad, has resigned.

JAMES L. RANDOLPH, ex-chief engineer of the Baltimore & Ohio, and who had been for many years connected with the engineering department of that road, died suddenly at his home near Jessup's, Md., some days ago.

JAMES B. HOGG has been appointed Chief Engineer of the Port Townsend & Southern Railroad, with headquarters at Port Townsend, Wash. Ter.

A. R. HORN, of the Chicago division of the Wisconsin Central, has been appointed Superintendent of the St. Paul division, vice J. C. CLIFFORD who has been transferred to the Chicago division.

S. F. RANDOLPH, Superintendent of the western division of the Nypano, has resigned.

HORACE G. YOUNG, Supt. of the Delaware & Hudson R. R. has been elected a trustee of the Rensselaer Polytechnic Institute, at Troy.

JAMES W. WAY, has been appointed Chief Engineer of the Missouri Pacific leased and operated lines with office at St. Louis. He will have charge of all new construction and all matters pertaining to right of way of the above lines, and will be custodian of the engineering records of the companies. He will also perform such duties in connection with maintenance and renewal of the the properties as may be assigned to him by the General Manager.

MEADE STILLWELL, recently connected with the Kansas & Arizona Division, has been appointed Division Superintendent of the Kansas City section, Lexington Branch, Jefferson City, Boonville and Lexington and Sedalia, Warsaw and Sonthern Divisions, of the Missouri Pacific Railway, to succeed W. E. GRAY, resigned. W. E. GRAY becomes General Superintendent of the Kansas City & Southern, which will be opened for business Oct. 1.

RUDOLPH HERING, of New York, has been selected as an Expert to thoroughly investigate the question of efficient sewage for Toronto Ont.

G. CASTOR SMITH died at his residence in Philadelphia on Sept. 15, at the age of 82 years. Mr. SMITH was connected for more than 50 years with the U. S. Engineer Department and Light-House Establishment, and the U. S. Treasury Department, by a special circular, testifies to his unblemished probity, faithfulness and intelligence in the discharge of his duties and responsibilities. He was connected with the early surveys of the Mississippi in 1850, the initial steps for the construction of the Delaware Breakwater and Fort Delaware, with the building of light-stations at Assateague, Atlantic City and Barnegat and Jupiter Inlet; he was Act. Engineer of the Fourth Light-house District 1862-70. Vice Admiral STEPHEN C. ROWAN, Chairman of the U. S. Light House Board, formally announces his death and gives a full record of Mr. SMITH'S service as a memento of the "life work of a faithful servant and citizen of the United States."

CORRESPONDENCE.

A Cross-Section Mnemonic.

Missouri School of Mines.
ROLLA, MO., Sept. 14, 1888.

EDITOR ENGINEERING NEWS:

While in the investigation of principles the mnemonic or artificial aid to the memory is pernicious and to be avoided, its utility in practical application cannot be denied. The practising engineer caring only for results, demands first that they shall be correct, and next that they shall be reached in the simplest and shortest possible manner; and labor saving methods of computation always find with him a welcome.

For the area of the cross-section of the roadbed formation in railway construction we have given algebraic formulæ for the computation of the same only up to three level sections. Beyond that form the formulæ become so complicated and cumbersome as to be practically useless, which difficulty has led to either one of the two practices, viz., to take the necessary readings for the irregular profile and obtain the area by plotting on cross-section paper, or arithmetically by computing the areas of the separate trapezoids and triangles of which the section is composed, or otherwise the engineer in the field selects such points with his eye as will give a three-level section of approximately the same area, which is recorded in the notes as such, while the side stakes are marked with their proper figures. Either custom is to be condemned, the first because of the office labor of computing the separate areas and the second because of its irregularity and uncertainty.

It is the object of the present paper to present a general formula or rather *memoria technica* for the computation of all cross-section areas, no matter how irregular, which shall be simple and uniform in application, and exact in theory, applicable to cut or fill, part cut and part fill separately and collectively.

It is the custom among railway engineers to record cross-section notes in the form of a fraction, writing vertical distances (cut or fill signified by an appropriate sign, usually + or —) as numerators, and the corresponding horizontal measurements in the section, "distances-out" as denominators, or the reverse.

Usually separate columns in the note book are reserved for recording the appropriate width of roadbed for each particular section. It is now proposed to complete the cross-section notes by recording the roadbed half widths in their proper places beyond each side stake records, and with the vertical distance zero—and as "distance out."

Thus, if d be center depth, and $h_1, h_2 \ldots h_s$; $k_1 k_2 \ldots k_s$, the depths right and left out to the side stakes respectively, and $m_1 m_2 \ldots m_s$; $n_1 n_2 \ldots n_s$, their respective distances out, while the half road breadths are b and b^1, to the right and left respectively; then the complete record of the general cross-section would appear in the notes as

$$\frac{o}{b_1}\ \frac{k_s}{n_s}\ \cdots\ \frac{k_2}{n_2}\ \frac{k_1}{n_1}\ \frac{d}{o}\ \frac{h_1}{m_1}\ \frac{h_2}{m_2}\ \cdots\ \frac{h_s}{m_s}\ \frac{o}{b}$$

Usually $b = b^1$, and should the section be part cut, part fill some h or k will be zero.

The double area of the cross-section will be given by the mnemonic formula,

$$\frac{o}{b_1}\times\frac{k_s}{n_s}\times\frac{k_{s-1}}{n_{s-1}}\times\cdots\times\frac{k_2}{n_2}\times\frac{k_1}{n_1}\times\frac{d}{o}\times\frac{h_1}{m_1}\times\frac{h_2}{m_2}\times\cdots\times\frac{h_s}{m_s}\times\frac{o}{b}$$

[Nothing in the printers font will exactly imitate the character desired, consequently our readers must imagine the light stroke of the X as dotted. ED. ENG. NEWS.]

in which the heavy and dotted lines indicate the product of the quantities which they join, with the distinction between them, that the heavy line products are positive and the dotted line products negative. The algebraic sum of all the products is the double area of the section. Wherever zero is a factor, the products of course vanish.

The same thing expressed as an arithmetical rule, is as follows:

Beginning at the ends, add together the products *up* from the ends to the center each way; also the products *down* to the center each way; half the difference of these two sums is the area.*

The truth of the result may be more satisfactorily verified by testing a variety of particular cases, two examples of which will be taken as illustrations, remembering that in the notes + and — have no algebraic signification, merely identifying cut and fill.

In the cut section

$$\frac{0}{9}\ \frac{+27}{36}\ \frac{+21}{18}\ \Big|\ \frac{+16}{0}\ \Big|\ \frac{+9}{7}\ \frac{+3}{14}\ \frac{+12}{21}\ \frac{0}{9}$$

the sum of the *up* products is 1696, that of the down products 675, the area is therefore 510.5.

In the part cut and part fill section

$$\frac{0}{9}\ \frac{+20}{29}\ \frac{+7}{10}\ \Big|\ \frac{0}{5}\ \Big|\ \frac{-5}{0}\ \frac{-7}{8}\ \frac{-12}{25}\ \frac{0}{7}$$

we operate on the portion of the area required, thus for cut

$$\frac{0}{9}\ \frac{+20}{29}\ \frac{+7}{10}\ \frac{0}{5}$$

the sum of the up products is 383, that of the down 200, and the area +91.5.

In like manner for the fill

$$\frac{0}{5}\ \frac{-5}{0}\ \frac{-7}{8}\ \frac{-12}{25}\ \frac{0}{7}$$

* As an application of elementary geometry the truth of this rule is easily demonstrated by adding together the areas of the trapezoids which make up the profile figure and subtracting those of the two triangles under the slopes in the regular way. Expressing these areas in their literal dimensions for sake of generality, we have after reducing, for the area A

$$2A = (dm_1 + h_1 m_2 + \ldots + h_s b) - (h_2 m_1 + h_3 m_2 + \ldots \times h_s m^s(-)_1 + (dn_1 + k_1 n_2 + \ldots + k_s b^1) - (k_2 n_1 + k_3 n_2 + \ldots + k_s n_{s-1}).$$

Otherwise, the student of coordinate geometry will observe that it is a simple interpretation of the expression for the area of a polygon in terms of the coordinate of its corners; grade and the vertical through the center line being the axes of reference, "grade-heights" and "distances-out" being ordinates and abscissas respectively of points when readings are taken (Salmon, Conic Sections, p. 31).

the up products give 324, the down 96, with area —114.

The system is perfectly general and applies in every case.

In actually computing areas the numerical work may be shortened in various ways which will become obvious to the computer. Generally where large multiplication tables are at hand the work is reduced to addition and subtraction.

The chief advantage being that every cross section note stands for its area, into which it is turned by a simple uniform mechanical operation in arithmetic, which enables all areas to be checked or originally computed by a rodman or assistant whose attainments do not extend beyond arithmetic.

W. H. ECHOLS, C. E.

[The method is certainly ingenious and new, yet the nature of the very strong and conclusive objection to its use in practice is indicated by the fact that the area computed for the very first example section is not correct. Instead of being 510.5 sq. ft., the true area is 518.57 sq. ft. of cut *and* 8.07 sq. ft. of fill in addition. In other words, the section is not in fact a true polygon enclosing a single area, as the method assumes, but the lines overlap each other. There can be no stronger proof of the need for what should be an invariable rule, that *all* cross-sections, when there is any considerable amount of irregularity in the ground, *must* be plotted as soon as possible after taking the sections and by the same person who took them, the computation being from the plot and preferably by the planimeter when many sections are irregular. Errors which are otherwise almost certain to occur, both in the field work and the notes are thus avoided. It may be urged that the error in the above example is a mere slip of the pen due to writing off hap-hazard an imaginary section, and would not have occurred in the field; but it is easy in the field to compute a 5 ft. cut as 3 ft. or to write down 3 when 5 is meant, or to write 5 in intent and have another person read it 3. For this reason our decided opinion is that even 3-level sections should always be plotted except when the ground is nearly level.

Again, to compute the first example as proposed, 10 different multiplications must be made, besides the 4 multiplications by zero, which we may throw out. To compute the same section from the notes only, in the more usual way, only 8 multiplications are required. Taking fractional instead of even feet this alone would go far to balance the convenience of the routine rule. But after having made the plat, only 5 multiplications are necessary, which in practice can be reduced to only 3 or 4.

We can therefore only repeat what we have said before, that it is a pity engineers will not learn and agree on the few and simple methods which afford maximum accuracy and minimum labor at one and the same time, and close their mathematical construction account, in this line.—ED. ENG. NEWS.]

PUBLICATIONS RECEIVED.

Preparing for Indication: Practical Hints, the result of twenty-three years experience with the Steam Engine Indicator. By ROBERT GRIMSHAW, M. E., etc. Profusely illustrated, 1888; Practical Publishing Co.; 21 Park Row, New York. Price, $1.00.

This is another one of MR. GRIMSHAW'S publications on the use of steam, having in this case especial reference to preparing an engine for attaching an indicator and its piping and taking cards. There are plenty of works describing the manipulation of the indicator itself, but this is the first treatise, to the best of our knowledge, on the equally important feature of making the preparatory attachments, and as such should be exceedingly useful to the users of steam.

How Best to Light our Country Homes and Resorts. Some practical suggestions emphasized by illustrations of a few that are so lighted. GILBERT and BARKER MANUFACTURING CO., 75 Maiden Lane, N. Y. 1888.

This advertising circular of 60 pages is a gem of artistic typography and illustration. The circular proceeds in the plainest and most business like way, but in beautiful type printed on plate paper and illustrated with the most superb engravings of landscape, and interior architecture, to point out the many acknowledged excellences, the cheapness of maintenance and the general efficiency of the Springfield Gas Machine, clinching their arguments in its favor by a list covering 30 pages of users of the machine, a list which includes a great many notable people and summer resorts, in every State of the Union and in the Sandwich Islands and South America.

Plate Girder Construction. By ISAMI HIROI, Asst. Professor of Civil Engineering in Sapporo Polytechnic Institute. Formerly Asst. Engr. in Edge Moor Iron Co. Van Nostrand Science Series, No. 95. Price 50 cts.

A text book devoted to plate-girder work alone is somewhat of a novelty in engineering literature, and this little book should be a welcome addition to any engineer's library. While a plate girder is among the most common of structures in use, and their construction is usually looked upon as simple, the correctness of design, proper proportioning of its parts, spacing of the rivets, etc., are really among the more complex of the duties of the designing engineer. MR. HIROI here aims to solve the problems presented, in a simple rational manner and with special reference to American practice.

Prof. ARTHUR T. HADLEY, of Yale, author of "Railroad Transportation, its History and its Laws," contributes to *Scribner's* for October an article on "The Railroad in its Business Relations"—a subject following naturally the previous papers in the Railway series, which have treated entirely of material and mechanical interests.

Like all of Prof. HADLEY'S articles on this subject, it shows great study and intimate knowledge of it, and is well worth reading.

The Canadian Pacific Railway.

II.

The engine crews, as a rule, as also the freight conductors and brakemen, run over one "section" or locomotive division only. The passenger train crews, for the most part, run over the sub-divisions under an Assistant Superintendent. The wages of conductors and brakemen are exclusively by the day or month, with no regard to mileage, and range somewhat lower than is usual in the States, as follows:

Conductors, passenger	$2.00 to 2.30 per day
" freight	1.75 to 2.10 "
Baggagemen	1.40 to 1.77 "
Brakemen	1.25 to 1.50 "

The engine crews are differently paid; on the main line in exact accordance with mileage, and elsewhere in approximate accordance therewith. There are three classes of both engineers and firemen, promotion from one to the other being on good behavior at the end of each year of service, as in the disputed regulations of the C. B. & Q. which caused the great strike. The general rates on the Ontario & Atlantic division per day are:

	1st	2d	3d	Detention
Engineers	$2.25	$2.50	$2.70	20 cts. per hour
Firemen	1.30	1.45	1.50	10 " "

On the Eastern Division, pay rules somewhat higher, and on the Western Division (largely through a wilderness) higher yet, and strictly according to mileage; the schedule for the Western Division being as follows:

Description of work.	Engineer's class.			Firemen's new rate class.		
	1	2	3	1	2	3
Passenger train p. 100 m.	3.50	3.00	2.50	1.85	1.85	1.65
Freight & mix'd p. 100 m	3.75	3.25	2.75	2.00	1.85	1.65
Wood train p. day 12 hrs	3.75	3.25	2.75	2.00	1.85	1.65
General repairs 12 hrs	3.75	3.25	2.75	2.00	1.85	1.65
Shunting engines "	3.00	2.75	2.50	1.90	1.85	1.65
Heavy con'd eng. "	4.00	3.50	3.00	2.25	2.00	1.75
" (standing) "	2.00	1.75	1.50	1.12½	1.00	87½
Light running p. 100 m.	3.50	3.00	2.50	1.85	1.85	1.65
Detention p. hour	32½	32½	32½	18	18½	16½
Shop time & wate'g p. hr.	25	25	25	18	18½	16½
Travelling passenger	Dead	head	half	pass s'g'r		rates
Bonus per month	6.00	6.00	6.00	3.50	3.50	3.50

Bonus of Engineers on Consolidated Engines $20 per month
" Firemen " " " $10 "

The history of the road in brief is this: The Dominion of Canada was formed in 1867, soon after the close of our civil war, and it may be added too soon after the close of it for the highest wisdom to prevail in constructing the skeleton of another republic on this continent. The separate Provinces have no such independence as our States; their "Lieut. Governors" are appointed for them by the Dominion Government, their provincial laws are subject to veto by the same, and more than all else the Provinces are financially dependent on the Dominion, drawing an annual subsidy, an allowance for "government," for interest on local debt and what not, which has led to more or less of a continual scramble for a larger share of the loaves and fishes, and which has likewise led the Provinces which came into the Union last to insist on certain special provisions or expenditures for their benefit as a condition of coming in at all. Quebec, Ontario, New Brunswick and Quebec formed a union on July 1, 1867, but it was not till 1870 that the Hudson's Bay Co's. rights were extinguished in Manitoba and the North West Territory and not till 1871 that British Columbia was admitted. It then only came in on the condition (1) that it had a disproportionately large representation and (2) that the Canadian Pacific Railway should be built to connect it with the East within 10 years. Prince Edward Island only came in in 1872, likewise on condition of a railway being built by the Dominion within its limits. Newfoundland is still recalcitrant; but in the negotiation for its union, a public railway is one of the conditions asked for its union.

Independently of the British Columbia conditions, however, the union having been formed to include all British North America, the Canadian Pacific Railway became a palpable political necessity, to minimize so far as possible the geographical disadvantage of the Dominion, that its inhabited and habitable area is separated by vast stretches of (for the present at least) barren wastes. Between the maritime Provinces (population 870,696 in 1881, including 108,891 in Prince Edward's Island) and Quebec there is a north and south belt of 300 miles more or less of rocky and almost uninhabited territory extending from southern Maine to Labrador. Then come the two main Provinces of Quebec and Ontario with 3,282,245 inhabitants, nearly or quite 95 per cent. of whom live south of a straight line drawn from Quebec to the southernmost point of Georgian Bay, although there is considerable very fair farming territory to the north of this line extending along the Canadian Pacific Railway to and beyond Lake Nipissing. Then there is a vast stretch of rocky wilderness north of the great lakes extending over 1,000 miles, to within a few miles of the Red River valley at Winnipeg, which is almost without agricultural capabilities, and in great degree without valuable timber as well, although the aggregate of good timber which will become increasingly valuable is beyond question great, and the mineral resources, as yet almost wholly undeveloped, still greater.

Then comes the great wheat country of Manitoba which unquestionably has a great future before it. The present population is small, and, what is more ominous, does not show much tendency as yet to rapid growth, the population having been in 1871, 18,995, in 1881, 65,954, and in 1886 only 108,640; an increase of only 42,686, although the Government reports show that 155,154 settlers went to Manitoba and to the North West Territory between 1881 and 1886, of whom about 16,000 settled and remained in the Territories. But it is impossible to resist the conviction that political or other extraneous causes are largely responsible for its present slow growth, and that the region of which Winnipeg is the center will yet support a population of millions. If so, it cannot be long before their difficulties will be removed, and Manitoba alone will then afford an immense traffic to the Canadian Pacific.

The very choicest belt of the Manitoba lands extends for about 200 miles along the line of the Canadian Pacific, being much wider than the corresponding belt in Dakota, but for at least 350 to 400 miles from Winnipeg the region is one of the greatest promise, and is already pretty well settled up at many points. The disadvantage of the more westerly section is (1) that the soil is thinner, and (2), a much more important difference, the surface is about 1,000 ft. higher than Winnipeg, which is at the very low altitude of 700 ft. This makes a material difference in the climate; but on the other hand, the climate grows milder as the Rocky Mountains are approached. As a whole, all this great belt of 400 miles is a region of great promise, but as yet of very thin population.

Beyond this comes a vast stretch of plains, in part alkali, extending to the foot of the Rocky Mountains nearly 900 miles from Winnipeg, and resembling closely the corresponding belt of Western

Kansas and Nebraska. The westerly 100 miles of this belt is a fine grazing country already well occupied, and it is claimed that the whole of it is superior to corresponding land at the South, and of great agricultural capabilities. To what extent this is true we will not now consider. It is sufficient now to say that it is for the present almost uninhabited except in the grazing belt referred to, the center of which, Calgary, is a growing town of some 2,400 inhabitants; and that for 550 miles further west, to the Vancouver terminus, 2,906 miles from Montreal and 1,483 miles from Winnepeg the country is a "sea of mountains" of the grandest picturesqueness, but as yet almost uninhabited; British Columbia being chiefly a settlement along the coast, and having a total population of only 49,459 in 1881, 30,011 of whom were Indians and Chinese, leaving only 19,448 whites in the whole vast area, who certainly cannot complain of "taxation without representation" since they have 6 members in the Dominion "House of Commons", or one to every 3,241 whites, 2 Senators (appointed for life), and for local government a Lieut. Governor (appointed), a "Premier", heading a Cabinet of 6 Ministers, and a Legislative Assembly of 27 besides.

Under all the above conditions, with Manitoba and British Columbia wholly without a connection with the Eastern Provinces except through the territory of the United States, a transcontinental railway was a palpable political necessity. It was a tremendous undertaking for so small a population, and the people of Canada have done themselves great honor by the manner in which they buckled to the work and triumphantly carried it through. With so thin a population along the line, public aid for its construction was a necessity, and has been given most generously. The financial history of its construction has been this:

In 1872 a private company was subsidized with a grant of $30,000,000 cash and 50,000,000 acres of land, to build the road in 10 years. They failed to do anything. The Government (under a different party) then took it up as a public work, and began in 1875 the construction of the section from Winnipeg to Port Arthur, 420 miles, which it finally finished and gave to the present company as a free gift, as also 213 miles of heavy work at the Pacific end. In 1880, the Conservative party being again, as now, in power, organized a new private company, agreeing to complete the road by May, 1891, which has carried through and still manages the work. It has received in all the following financial aid from the Government:

1. A subsidy of $25,000,000 (a gift and not a loan, as on our Pacific roads) and 25,000,000 acres of selected land in the fertile belt.

2. Free imports of all material, the pecuniary value of which would be hard to estimate exactly; perpetual exemption from all taxation, including exemption of the unoccupied land grant for 20 years.

3. A free gift of 700 miles of line which the Government had then built or was building, viz., 213 miles on the Pacific end, 430 miles east of Winnipeg, and some branch and abandoned lines of relatively small importance in Manitoba. The two first named sections, were very heavy work. They have cost to date over $30,000,000, and the Rocky Mountain section was much skimped in construction and will probably have to be finished by the Government according to contract at a cost of several millions more. An arbitration is now pending to decide how much, if any, the Government has fallen short of its obligations, and will almost certainly find for a large sum.

4. Loans during construction, which at their maximum were $29,880,000, but which have since been repaid (a rather remarkable fact, and a very creditable one to the company) with an aggregate net result of $10,189,510 cash from the Government in return for the surrender of 6,793,014 acres of land at $1.50 per acre.

5. The original contract had a cast-iron "monopoly clause" against any connections with American lines to the South for 20 years, by forbidding the authorization of any line to the south of the Canadian Pacific which did not run either Southwest or to the west of Southwest, *or* which ran within 15 miles of the U. S. boundary line, so that traffic could not even be hauled to the boundary by wagon. This led to such great and threatening discontent in Manitoba that the Government was obliged to purchase a release from the company by a guarantee of 3½ per cent. interest on $15,000,000 of bonds, in return for which the company in effect surrendered to the Government its remaining unsold lands, of about 15,000,000 acres. The present worth of an annuity of $1 per annum for 50 years at 3½ per cent. is about $23.80, which makes this transaction in effect a sale to the Government of 14,934,237 acres land for $12,495,000 cash with permission to the company to get more out of the land than that sum if it can.

The total aid to the company has therefore been:

643 miles main line @ $46,700 per mile, over..	$30,000,000
Probable addition to complete same properly, say.....	4,000,000
On the remaining 2263 miles of main line and great system of branches:	
Cash subsidy.....	$25,000,000
First sale of land to Govt. @ 1.50 per acre..	10,189,541
Second sale of land @ 83 cts. per acre.....	12,495,000
Cash realized over cost of sales from sales of 23,272,749 acres of land, which is all of its land grant which the company has not surrendered for cash, $8,425,173 including bonds, or stay in cash or equivalent.....	7,500,000
Total gifts of cash or equivalent by Govt..	$90,184,541

This is not exactly the total which appears in the Government Blue-books, but it is the real aggregate, barring fractional errors. It amounts to an average of $31,000 cash per mile of main line from Montreal to Vancouver. Since the world began, perhaps, there has been no instance of gifts by a Government to a private company on an equally grand scale; but it does not follow that the Government has done too much, or has not got its money's worth; on the contrary we shall see reasons why it has had its full money's worth. The land sold by the company, for example, was worth almost nothing to the Government without the road. Its construction has unquestionably, we take it, added much more than the above sum to the present wealth of Canada; but the difference, and it is a great one—is that these indirect profits would in this and most other countries have gone into the pockets of private individuals to stay there; while in Canada they have to be paid out again, to the aggregate of $83,000,000, in taxes to pay off the above debit side to their gain.

In the meantime the securities disposed of to private individuals have been, first, $65,000,000 stock sold prior to 1883, and secondly $35,000,000 5 per cent. first mortgage bonds sold in 1886-7. There are also some $10,000,000 or $12,000,000 of other bonds for branches, etc., and several millions of floating and miscellaneous liabilities into which we need not enter. The cost of road, lines built by Government not included, stands on the books as follows (Dec. 31, 1887):

Main line 2,263 miles @ $51,530 per mile.....	$116,618,039
Branches and acquired lines.....	19,071,590
Equipment, steamers, shops and machinery	10,570,933
Advances and expenditures for leased lines	1,900,287

(TO BE CONTINUED.)

ENGINEERING NEWS.

THE work of replacing the bridges on the Newark branch of the New Jersey Central, is being pushed vigorously and will be completed before winter. Through plate girders are used at the street crossings in the City of Newark, as the head room was not sufficient to permit of the use of deck bridges. During erection the tracks are carried by timber trestles and the material is handled by cranes. This work is being done by Cofrode & Saylor. The two new draws at Newark Bay—one of 212 ft. and the other of 172 ft. span—are being built by the New Jersey Steel & Iron Company. These bridges will be erected in a manner similar to that pursued on the main line crossing the Bay. Traffic will be carried on gauntlet tracks, on a trestle built around the center, or pivot, pier, upon which the new draw will be erected. A temporary draw will be placed in the circle to accommodate navigation. This work will remove a peculiar specimen of bridge architecture, consisting of two spans of bow string girders, the swinging ends of which are supported from a central gallows frame.

THE DRAINAGE OF THE VALLEY OF MEXICO is to be attempted by the Shone Company of London, according to the latest news on this ever-appearing project. The papers are said to be all signed and English money and engineers are to do the work.

THE WEST SHORE RAILROAD CO. has been at work for some time past arching the West Point tunnel, which is 6,700 ft. in length, at a cost of some $200,000. The change is said to be necessitated by "quick sands in the rocks". Nine trestle bridges, aggregating 6 miles in length, along the line of the West Shore are also being filled in, the longest one being a short distance this side of Albany.

MAYOR W. HAZELTINE and Supervisor ROBERT MOORE, both of Richmond County, and Lieut HANNIS, U. S. N., have been appointed by Gov. HILL as New York Commissioners for making out and determining the boundary lines between New York and New Jersey on the Arthur Kill, Kill von Kull, and New York Bay, extending from Tottenville, Staten Island, to the Battery, this city. Gov. GREEN of New-Jersey has appointed Prof. GEORGE COOK, ROBERT BACOT, Riparian Commissioner of Jersey City, and W. OLIVER of Elizabeth on the part of that State. At a meeting last Saturday Prof. COOK was elected President, and E. P. DOYLE, of Staten Island, Secretary.

THE PEOPLE'S RAPID TRANSIT CO. has filed articles and the necessary maps showing the location of the line from the Battery, New York City, to Tarrytown. The novel feature of this scheme is the proposition to build a four-track road on a purchased right of way through the blocks, crossing streets at such an elevation as to avoid all interference with traffic. The line runs west of Broadway to Franklin St., where it curves to the Hudson, then passes to the Battery and East river and returns to Franklin, thus embracing the lower part of the city in a loop. When the estimated cost of $30,826,648 for real estate and $23,433,538 for viaduct was published some time since, the impression was prevalent that the estimate was far too low. The company has, therefore, appointed Prof. WM. P. TROWBRIDGE, of Yale, and WALTER SHANLY, C. E., of Montreal, a committee to examine both plans and estimates. Their report will probably be made next week.

CUTTING GLASS BY ELECTRICITY is the latest trick of the Pittsburg glassmakers. Window glass is first turned out in the shape of large cylinders, and the old method of cutting these was by quickly wrapping a thin shred of hot glass around the cylinder, with the result of fracturing or burning the glass. Instead of this a fine wire is now used connected with a small electric battery. The wire adheres closely to the glass and, on passing a current of electricity through it, the glass is heated and a drop of water brings about the fracture. The thicker the glass the better the cut, is the experience in this new process.

THE BULGENSTOCK ELECTRIC RAILWAY, recently opened at the mountain of that name near Lucerne, ascends 1330 ft. in 3076 ft. It commences with a gradient of 32 per cent. and after 1312 ft. it increases this to 58 per cent., and this later is maintained about to the top. It is single track, has one curve through 112° and the motive power is electricity generated by two 25 H. P. dynamos worked by water power of 125 H. P. nominal on the river Aar, 3 miles away. The loss of power in transmission over insulated copper wires is estimated at 25 per cent.

THE FRENCH MINISTER OF PUBLIC WORKS has issued a circular to the prefects informing them that, with certain exceptions, no sanction will be granted henceforward for the construction of railways or steam tramways having a gauge greater than one metre. It appears that any further extension of the French railway system must be by narrow gauge lines, only such being considered capable of earning their cost of working as feeders and cross country connections for the main lines.

PINE STRAW BAGGING.—Last week experiments were made in Charleston with a substitute for jute cotton baling that promises untold benefit to the entire South and woe to the jute trust now giving trouble there. According to the published accounts, this new bagging is made from the leaves of the pine tree, the prevailing forest wood of the South. It stood the test of going through the compress; it was tossed about with hooks for 15 or 20 minutes by the longshoremen; it shed water and stood a fire test as well as jute and did not stain the cotton. If

all this be true, a new material has been found at home for a foreign and cornered article of very common use.

THE ELECTRICAL ACCUMULATOR AND LIGHTING COMPANY., of St. Louis, has just been organized and will immediately begin the erection of a 10,000 electric light plant, under the accumulator storage battery system. The company will have a capital stock of $250,000. The parent company is the Electrical Accumulator Company of New York. Through the parent company the enterprise is said to be backed by such men as WM. L. HILL, manager of the New York Life, and CHAS. SUTTER, Vice President of the Sutter Art Glass Company. DAVID J. HARRIS is the electrician of the parent company.

THE LARGEST BESSEMER STEEL CASTING ever attempted any where, is claimed to have been that made at the works of the Pittsburg Steel Casting Co. on Sept. 17. It was intended for the stern port of one of the war ships now building at the Brooklyn Navy Yard. The casting is L-shaped with two arms of 26 and 13 ft.; parts of the casting were 42 in. thick. The casting weighed 22,000 lbs.: and finished it will weigh 18,000 lbs. The pouring was made from one 9-ton and one 2-ton ladle in 1 minute 14¾ seconds.

THE STEEL CAISSON for the Chicago water-works tunnel was successfully launched on Sept. 24. Divers are now at work attaching chains to rings on the bottom by which it can be slung to the "camels" or floats, and then towed to its destination, two miles out in the lake, as soon as wind and water are favorable.

THE KEELEY MOTOR must be opened up to the inspection of experts in all its details,or its alleged inventor must go to jail for contempt of court, is the decision of Judge FINLETTER of Philadelphia. Mr. KEELEY's attorney claimed that money was wanted to operate the machine. But the Court decided that this was no answer; that it was not necessary that the machine should work, but that it was quite sufficient for the inventor to exhibit and explain his drawings and take the machine apart and explain its operation. The experts must then simply report upon what they see. It would thus appear that Mr. KEELEY must at last do something besides seeking a permanent investment for the cash of confiding shareholders.

A CANAL DRAW BRIDGE.—The Manchester Ship Canal crosses the path of the old Bridgewater canal where the latter passes over the river Irwell on a viaduct built by BRINDLEY. As ships can not pass under the Bridgewater canal and the canal itself cannot be raised, the engineers have decided to pull down the old viaduct and to replace it by an iron trough, over the Manchester canal, which can be emptied and swung out of the way when a clear passage is required. This trough is closed by gates at either end, and hydraulic lifts are also provided by means of which barges can be transferred from one canal to the other. The whole arrangement is a successful solution of a novel problem in canal building.

SENOR EDWARDO RUBICO, Santa Barbara, Honduras, Central America, writes us that there is great demand for machinery of nearly all kinds in his section of the country, and he requests catalogues, etc., of anything that might be thought serviceable in Honduras. There may be profit in a compliance with our correspondent's request, which applies particularly to engineering machinery.

THE "STEAM BUGGY", which interested inventors 60 years ago, and was referred to by us in a late issue, appears again in France as applied to tricycles and quadricycles. M. SERPOLLET does not get steam for his motor as usually secured, but by "a generator of instantaneous vapor." His idea is to take a tube of thick iron; flatten this tube so that its inner sides are almost in contact and then coil the tube in a spiral over a furnace and heat it to 300° C. If water is injected at one end of this tube, it is spread out in an exceedingly thin sheet and is almost instantly vaporized by contact with the hot sides, and it leaves the other end as steam varying in tension with the length of the tube and the heat applied. The inventor claims that 1 H. P. can be developed from a tube 2m. long, 0,195m. wide, 0,032 m. thick and weighing only 70 lbs.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Great Northern.—

NEW GLASGOW. P. Q., Sept. 20, 1888.

EDITOR ENGINEERING NEWS:

Work was begun on the extension of the Great Northern Railway on Sept. 10. JOHN MCENCROE of Schenectady has the contract and expects to finish the road from New Glasgow, to Ste. Julienne, a distance of 18 miles, this fall. C. S. BAKER, 7 and 9, Place D'Armes Hill, Montreal is Chief Engineer; and F. X. MALO and G. T. DEFOREST, his assistants.

GEO. T. DEFOREST.

Hereford.—A press dispatch from Sherbrooke, P. Q., Sept. 24, states that contractors Shirley & Corbett, engaged in building this road, have disappeared with $25,000 just paid them by the company, leaving a large amount of unpaid debts due their hands. Work on their contract was about two-thirds completed. The company will take charge of the work and complete it. The road is to run from the terminus of the Upper Coos Railroad at the International Boundary to Cookshire, P. Q., on the International Ry.(Canadian Pacific),and is expected to be ready for operation by November. It is proposed to extend it from Cookshire north 11 miles to connect with the Quebec Central; also to build a branch from West Stewartstown to Ayer's Flats, on the Southeastern Townships Railway.

Rochester & Glen Haven.—Grading is in progress on this road under contractor E. M. HUNTINGTON. The line is to run from Rochester to Irondequoit Bay, nearly 4 miles. F. S. MINGES is President, E. W. MAURER, Secretary and WM. C. GRAY, Chief Engineer.

Pittsburg & Western.—The gauge of the northern division of this Pennsylvania road is to be widened to standard between Butler and Foxburg, 31 miles. New trestles have already been put in and rails are now being distributed.

Columbus, Hocking Valley & Toledo.—The suit of this company against STEVENSON BURKE and others, in which it was charged that the defendants had misappropriated funds to the amount of $8,000,000, has been decided by the board of arbitration, to which it was referred, in favor of the defendants.

Central Railroad of New Jersey.—According to the best advices, the Gloucester City & Atco Railroad,referred to last week, is an enterprise principally in the interest of this and the United States Express companies. A contract has been closed with the Gloucester Ferry Co. for the transfer of passengers and express across the Delaware river to Philadelphia. Right of way has already been obtained through the city of Gloucester and surveys are soon to be made to Atco. The terminal improvements proposed at Gloucester are of considerable extent, including a depot 70×120 ft., a car shed 200×500 ft., and a transfer wharf for running the cars upon the ferry boats. W. J. THOMPSON, of Gloucester is interested in the enterprise and can give information.

Silver Lake.—This road 7 miles in length from Perry, N. Y., to Silver Springs, it is proposed to extend from Perry to Moscow on the Delaware, Lackawanna & Western, about 7 miles. ARTHUR G. YATES, of Rochester, is President of the company.

Syracuse, Ontario & New York—Surveys are in progress for a branch along the west shore of Cazenovia lake, N. Y., principally for the convenience of excursion parties. ALBERT ALLEN of Syracuse is Superintendent.

Evansville & Richmond.—It is announced thatt he contract for the construction of this Indiana road has been awarded to Oliver Ferguson & Son. The general route for the line between Elnora and Columbus has been decided upon; but between Columbus and Richmond different routes are still under consideration. D. J. MACKEY, President of the Evansville & Terre Haute system, is back of the enterprise.

New Projects and Surveys.

George's Valley.— Contractors Mitchell & Spofford have offered to build this railroad from Union to Warren, Me., if the town of Union will raise a subsidy of $41,000. It is thought that the money will be raised, and the line be built next season. B. BURTON of Union can give further information.

North Attleboro & Wrentham.—The final survey is in progress on this Massachusetts road. There will be no grade crossings on the line, and the cost of the bridges will probably be over $100,000.

Oneida, Oneonta & New York.—This proposed line is to run from Oneida, N. Y., southeast to Oneonta, about 75 miles, *via* Morris, New Lisbon, New Berlin, Brookfield, and Augusta. At its northern terminus it will connect with the New York Central and West Shore and New York, Ontario & Western roads, and at Oneonta it will meet the Delaware & Hudson Canal Company's system and the Ulster & Delaware Railroad. The Brookfield Railroad, now under construction, will form part of the proposed line. WALTER F. RANDALL of Oneida is Chief Engineer.

Cincinnati, College Corner & Richmond.—This company has been organized at Richmond, Ind., to build a railroad from that city to College Corner, to connect with the Cincinnati, Hamilton & Dayton. Stock to the amount of $1,000 per mile has already been subscribed for. LEROY KELLY is President; WM. THOMPSON, Vice President; E. A. RICHEY, Secretary, and GEO. COTES, Treasurer.

Utica & Unadilla Valley.—A. C. COUCH, of Utica, is to undertake the construction of this New York road and work will begin soon at both ends of the line. D. E. CULVER has offered to take a controlling interest in the stock of the company.

Central Michigan.—This is the title of a projected railroad from Garrett, Ind., to Rogers City, 45 miles south of Cheboygan, Mich., of which PERRY W. BOYNTON is President and PERLEY H. BROWN, Secretary. According to a contemporary, the entire line, nearly 400 miles in length, has been surveyed, and 700 men are now at work on the grading.

Vincennes, Oakland City & Owensboro.—The contract for building this railway from Vincenn s, Ind., to Owensboro, Ky., has been awarded to the Central construction Co. of Henderson, Ky. J. C. RUDD of Owensboro is President.

SOUTHERN

Existing Roads.

Ohio River.—The first train is to run over the new Ripley & Mill Creek Valley Railroad on Oct. 1. The line is 12¼ miles in length.

East Tennessee, Virginia & Georgia.—A meeting of the stockholders of this company is to be held at Knoxville, Tenn., on Oct. 18 to vote on the proposition to issue not more than $6,000,000 of bonds to raise money for improving and equipping the line.——It is rumored that the company has secured a controlling interest in the Kentucky Midland railroad, now under construction from Frankfort, Ky., east to Paris.

Louisville & Nashville.—The report which has been going the rounds of the newspapers that the company intended to establish a through direct line from New York to New Orleans is stated by officials of the company to be entirely unfounded.——A report which seems to have somewhat more probability than the previous one is that the branch of the Birmingham Mineral division which now runs to Woodstock is to be extended to Tuscaloosa, Ala., and that the Warrior Coal Fields Railroad, which is to be built from Tuscaloosa to Meridian, Miss., is backed by the Louisville & Nashville.——Considerable progress is being made toward the double tracking of the North & South division. Long sidings are being put in at every station and the bridges are being altered.

Central Railroad of Georgia.—The corps of engineers in charge of J. W. CROSS has surveyed two lines for the division of the projected Savannah & Western Railway between Americus and Eastman, Ga. A survey from Eastman to Eden has already been made.

Chattanooga, Rome & Columbus.—The Chattahoochee Brick Company has filed a petition asking for the appointment of a receiver for this recently completed Georgia railroad, claiming that the Rome & Carrollton Construction Company, who sublet the contract to the Chattahoochee Brick Company, has not paid the sums due for the construction of the road. The company has also filed contractor's liens upon the road in each county through which it runs.

Louisville Southern.—The locating surveys are nearly completed on the extension from Lawrenceburg to Lexington, Ky., and contracts will be let soon. The citizens of Frankfort are trying to induce the company to build a branch to that city. A survey is in progress between Nicholasville and Richmond.

Mobile & Ohio.—It is announced that the company is obtaining right of way, and securing titles to valuable mineral properties along its proposed extension from Corinth, Miss., to Birmingham, Ala., and will start the preliminary surveys soon.

Northwest & Florida.—The work of improvement on this southern Alabama road is making rapid progress. Over 100 cars of new rails have been distributed along the line, and most of the bridges have been rebuilt. Four pile drivers are now at work on the remaining bridges, the cuts are being widened, and the whole 51 miles is expected to be ready for the standard gauge rolling stock, which has been ordered, by Nov. 15.

Charleston, Cincinati & Chicago.—A celebration was held at Yorkville, S. C., on Sept. 18 in honor of the opening of the line to that place. It is expected to complete the line from Yorkville north to Black's in two or three weeks.

Rome & Decatur.—Judge MADDOX ordered D. Callahan, the contractor who built this road, to turn it over to Receiver RUFUS T. DORSEY and possession was therefore given to the Receiver on Sept. 26.

Kentucky Midland.—Various conflicting reports regarding the sale of this road are in circulation. One is to the effect that it has been bought by a syndicate represented by MOSES LIPPMAN of Philadelphia and JAS. E. REDFIELD of Hartford, Conn. Members of the Board of Directors deny that any sale has been made or is contemplated.

New Projects and Surveys.

Buckhannon.—This company has been incorporated in West Virginia by J. N. CAMDEN, W. N. CHANCELLOR and V. B. ARCHER, all of Parkersburg, to build a railroad from Buckhannon, Upshur county, up the Buckhannon river to a point in Randolph county. The headquarters of the company are to be at Weston. The line is projected to open up a country rich in mineral resources.

THE NORTHWEST.

Existing Roads.

Eastern Ry. of Minnesota.—

154 E. Fifth St., ST. PAUL, Minn., Sept. 22, 1888.

EDITOR ENGINEERING NEWS:

The enclosed slip from this morning's *Pioneer-Press* is substantially correct. Schedule trains will begin running to-day. I think we may be pardoned for the pride we take in our 0.4 per cent. grade line all the way from the level of Lake Superior, the main rise of about 450 ft. being made on one continuous stretch of this grade unbroken except for compensation on curves, the more especially in view of the fact that all competing roads have 1 per cent. maximum grades and fully as much distance. The fact that the first train was run over the road just 1 year after I went over the route for the first time with packers and demonstrated its possibility, is principally due to the energy displayed by our President, Mr. H. D. MINOT and our contractors Messrs. FOLEY BROS.

SAM'L. ROCKWELL, *Chief Engineer.*

The clipping enclosed describes the first trip made over the road by the special train carrying the principal officers of the road, press representatives and others. The last spike was driven on 11 A. M., Thursday Sept. 20. The maximum curvature is 3° and the heaviest grade, as noted above, is .4 per cent. The rails are 75 lb. steel and the bridges are of timber, the one over the Kettle river is 800 ft. long and 135 ft. high.

A traffic agreement has been made with the Manitoba company, by which the latter will handle Eastern trains from Hinckley to Minneapolis and St. Paul, making the Eastern virtually a through line and giving it the benefit of the Manitoba's terminal facilities in both these cities. In return the Eastern will handle the Manitoba's traffic between Hinckley and Lake Superior, and for the accommodation of traffic in the three great products, wheat, flour and coal, termini are being built at West Superior, which will, when completed, eclipse anything of the kind on the lakes.

The Northern Steamship company's boats, three of which will be floating this fall, and three more in the spring, will run in direct connection with the Eastern road. In the yard a round-house of twenty stalls and a large store-house are now nearing completion, while the foundations are already in place for a general office building. The equipment of freight cars and locomotives is now ready for use.

The *Pioneer-Press* comments editorially on the new line as follows:

The opening of the Eastern Railway of Minnesota is an event of prime importance to the people of the Twin Cities and to the whole Northwest. Its importance consists not only in affording another competing outlet to Lake Superior, but in being part of a great new system of through lake and rail transit to the seaboard. For it is to be supplemented by a fleet of fast steel steamships of about 3,000 tons burthen, built according to the best ocean models and equipped with the most powerful machinery. One of these ships has already been built and is now plying between Buffalo and Duluth and West Superior, making the voyage in seventy-five hours with a heavy cargo—a much more rapid run than was ever accomplished by the fastest passenger steamboats. Another is about completed, and four or five others will be launched next year. The appearance of this fleet of first-class steamships upon the upper lakes will break up the virtual monopoly which has heretofore ruled the carrying trade of those lakes. It will considerably reduce the lake rate, and in connection with the Eastern Railway of Minnesota and the connecting lines of the Manitoba system will add immensely to the effectiveness and advantages of the Northern lake and rail route between Minnesota and the seaboard.

St. Paul & Duluth.—This company has begun running trains into West Superior over its new short line. It has been delayed for some time by the refusal of the Eastern Ry. of Minnesota to permit it to put in a crossing to connect with its line to the Union depot. On Thursday night, Sept. 20, a force was assembled and put in the crossing before the rival company could offer any resistance.

Duluth, South Shore & Atlantic.—A press report from Duluth states that the company has let the contract for grading the first 5 miles of its line from the Union depot in West Superior, easterly.

Northwest Central.—A meeting of the directors of this company was held at Ottawa on Sept. 21. Chief Engineer J. H. E. SECRETAN reported that owing to some heavy fills on the first 50 miles from Brandon, Man., northwest, the grade was not yet completed and it would be impossible to lay the rails on the whole division this fall.

Duluth & Iron Range.—The whole cost of the improvements in progress on this road between Two Harbors and Tower will be nearly $500,000. Grades and curves are being cut down so that much heavier trains can be taken over the road than at present.

Illinois Central.—A press dispatch from Austin, Minn., Sept. 21, says:

A full corps of Illinois Central railroad surveyors started from Lyle Wednesday to explore a line for the projected Austin, Mankato & St. Cloud railroad. They will cross the Cedar at Officer's mill, 5 miles below the city. Two lines are being run, one through the west part of this city, the other striking about 3 miles west of Austin. It is reported here that the contracts have already been let for the completion of the entire line before Dec. 1, 1889.

Chicago, Rock Island & Pacific.—There has been great interest in Wall Street over the prospect that this company would follow the example set by the St. Paul directors, and pass its dividend, and the stock has been fluctuating very sharply. Contrary to the expectation of many, the threatened reduction was not made, and the usual dividend of 1¼ per cent. was declared. No figures of earnings were given out, but President CABLE says the dividend was fairly earned.

Northern Pacific.—Work is reported to be already in progress on the terminals of the Red River Valley railway in Winnipeg. The bridge across the Assinaboine will not be completed for nearly a month, but it is pretty certain that trains will be running into Winnipeg by Oct. 15. The company is already making preparations to reach out into different parts of the province. Work will begin soon on the branch from Morris to Brandon, of which 20 miles are to be completed at once, and the remainder within the next year. Fifty-five miles of the the branch from Winnipeg to Portage La Prairie are almost graded.

Nebraska City Stockyard Co.—A Union stockyard company has been formed at Nebraska City, Neb., and has purchased the existing yards from the Mo. Pac. and B. & M. Railways. The yards are to be greatly enlarged, several miles of new tracks laid, and the contract for a large exchange building has been let. The Nebraska City and the Chicago Packing companies will enlarge their works to double their present capacity, or about 10,000 hogs per day. The Stockyard company will own all the shifting engines. A. F. NIMS, City Engineer, is engineer in charge of the improvements.

THE SOUTHWEST.

Existing Roads.

Cleveland, St. Louis & Kansas City.—The contract for the construction of the division of this road from Alton, Ill., to St. Charles, Mo., has been let to Col. EATON. The work to be first undertaken will be the bridge across the Mississippi river at Alton. Work on the approaches is to begin at once. J. P. K. HAYWARD, 518 Roe Building, St. Louis, is Chief Engineer and General Manager.

Missouri, Kansas & Texas.—Arguments for and against the appointment of a receiver for this company were begun before Judge BREWER at St. Louis on Sept. 25. JOHN F. DILLON for the Missouri Pacific stated that the company would not oppose the appointment of a receiver, but would insist that the receiver appointed should not be hostile to the Missouri Pacific's interests. SIMON STERNE, representing the M., K. & P. stockholders, opposed the receivership, and argued that the road should be turned over to its stockholders, claiming that the prospects for increased earnings were such that if left to itself, the company would soon recover from its temporary embarrassment and be able to meet all its liabilities. Judge BREWER decided that the road should be placed in a Receiver's hands. J. J. FREY, the present Superintendent of the road, is prominently mentioned for the receivership.

Gulf, Colorado & Santa Fé.—The citizens of San Angelo, Tex., celebrated the completion of the extension of this road from Ballinger to San Angelo on Sept. 17 and 18.

Mexican National.—The new iron bridge across the Rio Grande at Laredo is completed.

San Antonio & Aransas Pass.—Engineer B. F. HOUSE is making surveys for extensions to Fredericksburgh, Comfort and Llano. President LOTT has offered to build the extensions if the counties will grade them ready for the track. It is stated that the company contemplates an early extension to Laredo to connect with the Mexican National.

Ft. Worth Western.—It is announced that contracts have been let for building this Texas road. W. W. H. LAWRENCE of Ft. Worth is Vice President and General Manager.

Ft. Worth & Rio Grande.—A party of engineers is still at work locating the extension from Granbury to Brownwood, Tex., and the citizens of Brownwood have been asked for a subscription in aid of the enterprise.

Missouri Pacific.—McCarthy & Kerrigan, of Little Rock, reported as receiving the contract to build the Fort Smith & Gurdon R. from Fort Smith to Greenwood, have sublet the contract for the first 10 miles to John Lee; the next 5 miles to Baker & Son, of Fort Scott, Kan.; 2 miles to C. E. Brown, of Dallas, Texas; the 15th mile to W. J. Brown, of Little Rock, and the last three to Arnold Bros., of Forth Smith.—*Ry. Review.*

New Projects and Surveys.

Chicago, Hannibal & Springfield.—The Secretary, JOSEPH LATHROP is reported to have stated that work is to begin on this line, which is to run from Peoria, Ill., to Springfield, Mo., by early spring.

Trinidad, Caldwell & Arkansas.—This company has filed its charter in Kansas and proposes to build a railway from Bucklin, Ford county, via Coldwater, Medicine Lodge, Attica, Anthony, Caldwell and South Haven to Arkansas City, about 200 miles. The headquarters of the company are to be at Caldwell, and JOHN W. NYCE of Caldwell, G. R. SNELLING of Anthony, S. C. BELL of Attica and others are interested in the enterprise.

Kansas City, Watkins & Gulf.—The election held Sept. 20 at Lake Charles, La., to vote a 2½ mill tax for ten years to aid this company, was carried by a heavy majority in favor of the tax.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Silverton.—At a meeting of the stockholders held at Silverton, Colo., Sept. 15, it was voted to increase the company's stock to $350,000, and to build five short extensions, one from Red Mountain park through Uncompahgre canon to Ouray; one from near Ouray to the Virginius mine; one from near Silverton through Howardsville, Eureka, Animas Fork and Mineral Point to a connection with the main line; one from Silverton along the Cement Creek valley; and one from Animas Forks to Lake City. C. W. GIBBS of Silverton is Chief Engineer.

Denver & Rio Grande.—Chief Engineer BRIGGS has been examining the ore deposits at Ashcroft, Col., and it is believed that the company contemplates a branch to that point. It is also stated that General Manager S. T. SMITH has made a reconnoissance of the route for the proposed extension from Glenwood Springs to Grand Junction, and also the Saguache Valley extension. According to the Glenwood Springs *Ute Chief*, Attorney A. M. STEVENSON has been ordered to begin work obtaining right of way for the Salt Lake City extension.

Colorado Midland.—Corey Bros. & Co. have the contract for repairing the extension graded last fall from Glenwood Springs to New Castle, 15 miles, and it is to be ready for the rails in three weeks. The piers for the bridge across the Grand river were completed last fall, and a temporary bridge will probably be put in so that trains may begin running early next month.

——There was a serious fight at Aspen, Col., on Sept. 20, between 200 employees of this company, headed by President JOHN SCOTT, and 150 employees of the Denver & Rio Grande. The trouble arose over the refusal of the Denver & Rio Grande to permit the Colorado Midland to put in a crossing over the tracks at Ute Avenue. Shovels and picks were freely used in the melee and several persons were seriously injured, among them President SCOTT.

San Francisco & San Joaquin Valley.—No work is in progress on this California road at present except in the engineer's office. About 70 miles of grade have been completed and President I. E. WILBUR of San Francisco is now in the East endeavoring to obtain funds for the resumption of work upon the road.

Southern Pacific.—The company has finally decided to build the Templeton extension via the Cuesta Pass route. Engineers are now on the ground making the location survey for the 15 miles from the present terminus to the portal of the tunnel through the Coast Range, which will be about 4,000 ft. in length. Work on this tunnel will begin as soon as the railroad to that point is completed so that tools and supplies can be brought on the ground. The Tustin branch was opened for traffic on Sept. 15. It is 16 miles in length, from Conrad, midway between Anaheim and Orange on the San Diego division, to Tustin. Estimates have been made for the proposed bridge across the Carquinez straits, but there is no immediate prospect of the commencement of work.

Oregon & Washington Territory.—This company has filed a mortgage to the Solicitors' Loan and Trust Co. of New York City on 90 miles of its road from Wallula to Riparia to secure the payment of bonds to the amount of $1,500,000.

Oregon Railway & Navigation Co.—Kilpatrick Bros. & Collins, Contractors on the Washington and Idaho extension, have the grading nearly finished on the 35 miles from Farmington to Rockford, and about 12 miles of track are down. The Washington and Idaho company have filed complementary articles of incorporation in the office of the Auditor of Whitman county, under which they propose the construction of the following lines: (1) Farmington to Shokane Falls. (2) From near forks of Hangman Creek across the Coeur d' Alene reservation, along the east side of Coeur d'Alene lake and thence to Wardner. (3) From at or near Spangle to Coeur d'Alene Lake. (4) Milo, Idaho, to Mullan. (5) Mullan, Idaho to Missoula, Montana. (6) Endicott, W. T. northeast to connect with the Farmington and Spokane Falls line at a point 12 miles north of Farmington. (7) Up the north fork of the Coeur d'Alene river to Murray, Idaho, with a branch up Beaver Creek. (8) A line up Nine Mill Creek.

——President ELIJAH SMITH has been acquitted of the charge of contempt of court in proceeding with the construction of the bridge across Snake river and the new branch lines, against which an injunction was granted.

Portland & Vancouver.—The first train over this road from Portland, Ore., to the Columbia river, about 8 miles, was run on Sept. 16. R. A. HABERSHAM is Chief Engineer.

China Valley Narrow Gauge.—RICHARD GIRD, proprietor of this road between Chino and Ontario, Cal., states that it will be extended the coming winter to some point on the coast, about 20 miles distant, either to Alamitos Bay or to Newport. An extension has also been surveyed to Los Angeles and will be built. H. B. MARTIN, Chino, Cal., is Chief Engineer.

New Projects and Surveys.

Pueblo, Gunnison & Pacific.—A corps of surveyors have begun work on this Colorado road. H. R. HOLBROOK of Pueblo is Chief Engineer and THOS. ROPES of Topeka, Kan., is in charge of the party.

Stockton & Lodi.—A party of surveyors who are working north from Stockton, Cal., are supposed to be employed by this company. H. M FANNING of Stockton is interested.

Proposals Open.

Electric Lighting.—For putting in a complete plant in the city of Natchez, Miss., until November 1.

Machinery.—Materials for boilers and machinery, comprising pig-iron, ingot tin, anti-friction metal, steel boiler plate, steel shapes, steel forgings, finished steel shafts, steel castings, rivets and boiler tubes, condenser tubes and tube plates, corrugated furnaces, etc. Printed schedules, etc., may be obtained from and bids will be received by D. B. HARMONY, Acting Secretary, U. S. Navy, Washington, D. C. until Oct. 12.

Sewerage.—Extension of present sewerage system. Address CITY ENGINEER, Montgomery, Ala., until October 15.

Water Works.—Artesian well or water-works, for Douglas, Wyoming Territory. Address ALEXANDER T. BUELLER.

Dredging.—Channel at Mount Vernon, Va.; York river, Va.; Nomini creek, Va.; Breton bay, Md.; Pawtuxent river, Md. Specifications and information can be obtained of S. T. ABERT, U. S. Agent, 810 19th St., N. W., Washington, D. C. Bids received until October 15.

Metal Work.—Specifications and drawings can be obtained on application of WALTER L. FISK, Capt. of U. S. A., Light House Engineers, of New Orleans, La., for furnishing and delivering such metal work as is required to complete the Sea Horse Reef Beacon, Cedar Keys, Fla.

Laying Sidewalks.—For flagging walks in the 7, 18, 19, 22, 24, 24 and 25 th Wards, Brooklyn, at the Municipal Department Building, Department of City Works, until Oct. 2.

Canal.—For the formation and construction of the Sault St. Marie Canal, through the Island of St. Mary. Address A. P. BRADLEY, Secretary Dept. of Railways and Canals, Ottawa, Canada, for plans, map, etc. Bids received until Oct. 23.

Street Work.—Repaving Mercer street from Grove to Barrow streets, until Oct. 8. MARTIN FINCK, Clerk, Jersey City, N. J.

Sewers.—On Hamilton street, from Bruen to Union streets, with receiving basins, manholes, etc. Bids received until 4 o'clock, P. M., Oct. 2. CARL BAUMAN, Chairman Sewer Committee, Newark, N. J.

Contracting.

The Virginia Construction Co., of Richmond, Va. held its annual meeting recently and the following officers were elected: President T. C. LEAKE, Jr.; Vice President, D. T. PORTER; Chief Engineer, R. H. TEMPLE; Secretary and Treasurer, L. TRAYLOR.

Wharf Material.—The Harbor Commissioners, San Francisco, Cal., have awarded a contract for furnishing piles, for 12 months, to D. H. Bibb at 14, 15 and 16 cts. per ft. for 12, 14 and 16-in. piles. The contract for furnishing lumber for 6 months was awarded to L. H. Pierson, at $13 per 1000 ft. B. M.

Heating Apparatus.—At Louisiana, La., the contract for furnishing a steam heating apparatus for the new court house was awarded to N. K. LUDLOW for $3,600. Each bidder furnished his own plans. There were five bidders, all local plumbers, and their bids ran from $2,000 to $11,000.

Railroad Buildings.—The Memphis & Charleston R. R. Co. will commence work at once on the new machine shops at Sheffield, Ala. The cost will be about $300,000. The paint shop will be 40 × 100 ft.; machine shop, 100 × 200 ft.; blacksmith shop, 90 × 100 ft.; boiler, copper and tin shop, 90 × 100 ft.; wood-working shop, 90 × 100 ft.; car erecting shop, 90 × 100 ft; engine and boiler shop, 40 × 100 ft. A 30-stall roundhouse will also be built.

The Durham & Northern R. R. Co. will build a depot at Durham, N. C.

The Maine Central R. R. Co. will build a 36-stall roundhouse at Portland, Me.

Well.—At Murphysboro, Ill., the contract for the well was awarded Sept. 10 by C. H. SUNDMACHER, City Attorney, to Gray Bros., of Milwaukee, Wis. The other bidders were Ramsey, Adam & Rook, of Bowen, Ill.; H. G. Johnson, Salina, Kan.; J. P. Miller, Chicago, Ill.; Kinsley & Thompson, Smith Ferry, Pa. and Wellsburg, W. Va. Taney & Churchill, Indianapolis, Ind.; Sparks & Allen, Elgin, Ill.; H. W. Carter, St. Louis, Mo., and C. P. Brant & Co., of Lima, O.

Lock House.—The following proposals for building a frame lock house at the site for Lock No. 7, of the Great Kanawha river improvement, were opened Sept. 12 by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va.: David Eagan, Charleston, W. Va., lock house, etc., complete, except excavations and foundations, $2,375; excavation, 27 cts. per cu yd.; masonry, $4 per cu. yd.; pier stones, $1 each; total, $2,606.55. Martin V. Smith, Charleston, W. Va., $2,450, 27 cts., $5.25, $2, $2,758.05. Alexander H. Wilson, St. Albans, W. Va., $2,465, 30 cts., $5, $2, $2,762.50. Henry Crawford, St. Albans, W. Va., $2,600, 30 cts., $5.50, $1.50, $2,915.50. The approximate quantities of excavation and masonry in foundations, are, 65 cu. yds. of excavation, 50 cu. yds. of masonry, 14 pier stones. ADDISON M. SCOTT is Resident Engineer.

Extension of Contract Time.—The Board of Public Improvements, St. Louis, Mo., recently had a discussion over the delay in finishing some of the contract work let by the Board. It is expected that in future contracts the Board will make such arrangements that the contractor can be held to account for delays.

Milwaukee, Wis.—The big pumps of the new flushing tunnel were put in operation for the first time Sept. 14. Within half an hour afterwards the clear water from the lake was flowing into the dirty waters of the river. Everything is working satisfactorily. With the big flow it is expected to change the water in the main river every 24 hours.

Sewage Pumping Plant.—At Sioux City, Ia., the contract for the sewage pumping station has been awarded to W. P. Whitten, of that city, for $18,827. The pumps will be furnished by the Gordon & Maxwell Steam Pump Co., of Hamilton, O., and will be of the high pressure, direct acting, vertical plunger type; capacity 1,000,000 gals. per 24 hours. The plant was designed by Messrs. LOWETH & CURTIS, of St. Paul, Minn., consulting engineers for the city. Work will be commenced at once and will be carried out under the supervision of H. WINGELAND, City Engineer, and T. H. JOHNSON, Assistant City Engineer.

Gas Works.—At Richmond, Va., the Council Committee on Light has awarded the contract for the new retort house at the gas works to Capt. Henry White at $18,807.95. Work is to be completed by February, 1889. The other bidders were the Clay Gas Retort & Fire Brick Works, of New York, and the Baltimore Retort & Fire Brick Co., of Baltimore, Md. The building is to be of brick, with stone trimmings, and iron roof covered with corrugated galvanized iron; the building to have main walls of two bricks thickness, and in general dimensions to be 60 ft. long, 55 ft. wide inside, and 30 ft. high to wall plates. Also to construct in the building a complete stack of six benches of six retorts each (saying foundations for the ten benches), set with ordinary furnaces, all to be of first-class material. Also, to furnish and set up all the necessary iron work to completely equip these benches and connect them with the present plant, said iron work to conform in size and quantity to the superintendent's specifications.

Freight Shed.—The following proposals for an iron freight shed, 60x152 ft., at the Military Home, Dayton, have been received by the architects, PETERS & BURNS, of Dayton, O.: Columbia Bridge Works, Dayton, O., $8,849 with connecting shed, $7,849 without connecting shed; Walton Architectural Iron Works, Cincinnati, O., $9,490, $8,398; Lane Bridge & Iron Works, Chicago, Ill., $9,000, $8,000; L. Schreiber & Sons, Cincinnati, O., $10,673, $9,571. The contract was awarded to the Columbia Bridge Works.

Cable Railway.—*Denver, Col.*—VAN AUKEN & MEAD, of Denver, Col., are the engineers for the Denver & West Side Cable Ry.

Sewers.—*Mount Vernon, N. Y.*—The following proposals have been received by Committee on Water and Sewers for trunk sewers of 8-in. to 18-in. vitrified stoneware pipe: J. B. HEALEY, $42,868.25; Everson & Liddle, $43,884.75; Byron & Clark, $44,000.30; Adams & Co., $46,749.70; Brady & Brady, $61,731.45; F. H. Smith, $64,189.25; T. J. Chandler, $67,547. The contracts were awarded as follows: 1st and 4th Sections, Everson & Liddle, $21,074; 2 and 3rd Sections, $30,105.25. WM. E. WORTHEN, M. Am. Soc. C. E., of New York, is the engineer.

Dredging.—The following proposals for dredging in the harbor at Mobile, Ala., have been received by Major A. N. DAMRELL, U. S. Engineer's Office, Mobile, Ala. Alabama Dredging Co., Mobile, 9 cts. per cu. yd.; J. H. Gardiner, New Orleans, La., 9½ cts.; National Dredging Co., Wilmington, Del., 10¼ cts; Thos. H. Handy, New Orleans, 12 cts.; P. Schoss, Mobile, 12½ cts.; Atlas Dredging Co., Wilmington, Del., 14 cts.

The Westinghouse Engine.—The Westinghouse Machine Co., of Pittsburg, Pa., have issued a neat little pamphlet, giving "The Story of the Westinghouse Compound Engine", with indicator diagrams, views of the engines, a table of tests, and a table of sizes manufactured. It is got up very nicely and the text is in large clear type, printed in olive green ink.

Bridge.—At Sturbridge, Mass., the following proposals have been received for an iron bridge, pin connected. 60 ft. between abutments, 12 ft. roadway, floor capacity of 100 lbs. per sq. ft.; lumber for flooring furnished by the town. Penn Bridge Co., Beaver Falls, Pa., $1,350; Pittsburg Bridge Co., Pittsburg, Pa., $1,200; King Iron Bridge & Mfg. Co., Cleveland, O., $1,250; Wrought Iron Bridge Co., Canton, O., $1,100; Berlin Iron Bridge Co., East Berlin, Conn., $1,300; James H. Turner, Providence, R. I., $1,698; Springfield Iron Bridge Co., $1,250; Springfield Iron Works, $900. The Selectmen rejected all the bids and then made a contract with the Berlin Iron Bridge Co. for $800.

Bridges and Canals.

Bridges.—*Lancaster, Pa.*—The County Commissioners this morning opened the following bids for the erection of a bridge over the Conestoga creek, near Martindale: Iron superstructure—King Iron Bridge & Mfg. Company, $795; Pittsburg Iron Bridge Company, $780; Mt. Vernon Bridge Company, $787; Columbia Bridge Company, $726; Dean & Westbrook, $860; John Denithorne & Son, $819; Berlin Iron Bridge Company, $811; Wrought-Iron Bridge Company, $832. Wooden superstructure—John G. Bowman, $890. Masonry—John G. Bowman, $300. Wood and masonry—E. McMellen, $939. The contract was awarded to E. McMellen, he being the lowest bidder.

Washington, D. C.—The Groton Iron Bridge Co. has contracted to build the Woodley Lane bridge, and has commenced work. It will cost about $40,000.

Grenada, Miss.—The contract for building 3 iron bridges has been awarded to the King Iron Bridge & Manufacturing Co., of Cleveland, Ohio, at $5,250.

Laporte, Ind.—The Indiana Bridge Company has been awarded a contract for the construction of an iron bridge across Trail creek in Coolspring township. The estimated cost is $900.

Los Angeles, Cal.—The Trustees have awarded contracts as follows: California Bridge Co., Downey Avenue bridge, $57,640; First Street bridge, $67,400; and removal of First Street bridge, $3,000; San Francisco Bridge Co., Seventh or Ninth Street bridge, $5,973.

Bridges and Trestles.—Ross & Sanford, of Baltimore, Md., have received the contract to build bridges and trestles on the Chowan & Southern Railroad, from Drivers, Va., to Tunis, N. C., 36 miles, and from near Roberdel, N. C., to Tarboro, N. C., 37 miles.

Bridge Notes.—*Holyoke, Mass.*—City Engineer ELLSWORTH estimates the cost of a bridge over the canal at Dwight St. at $14,000 to $24,000, including abutments.

Hartford, Conn.—The stockholders of the Hartford Bridge Co. have voted to accept the award of $210,000 of the commissioners making it free. This will settle the question without further litigation or expense unless some of the towns interested take action.

Newington, Conn.—There are two propositions for a bridge over Pipers brook. One proposition is to build an arch bridge at a probable cost of $2,000 and to widen the causeway into a boulevard at an additional cost of $1,000, the other is to build a wooden bridge at a cost of $100.

Rochester, N. Y.—The Aldermen have again postponed action on the river bridge ordinances; they will come up again in October.

Troy, N. Y.—A new bridge is being erected over the Poestenkill at 2nd St.

Pulaski, N. Y.—The new iron bridge near the old bridge of the Syracuse Northern R. R., will be completed in November.

Philadelphia, Pa.—An ordinance has been introduced to appropriate $100,000 to construct a bridge over the Philadelphia & Reading tracks at the Thompson St crossing.—The Board of District Surveyors has approved the plans and specifications for the Schuylkill river bridge at City Ave.—The Survey Committee has directed a favorable report on the ordinances to appropriate $4,000 to build a bridge over Cobb's Creek, on the line between Delaware Co. and the city, the cost to be jointly incurred by Philadelphia and Delaware Co's.

Washington Co, Pa.—The Commissioners of Washington Co. have let contracts for repairing the bridges damaged by the recent flood.

Fayette Co., Pa.—The County Commissioners have decided to rebuild the three bridges recently washed away.

Hamilton, O.—A bridge is to built over the canal at High St.

Lynchburg, Va.—The Virginia Midland R. R. Co. will build an iron bridge over Blackwater creek.

Covington, Va.—The county is putting up four county bridges across Jackson River, to cost $22,500; one of them located here. Thomson & Withrow are the contractors.

Wheeling, W. Va.—The City Council has appropriated $50,000 for a new iron bridge, 170 ft. span, at Market St.

Grandview, W. Va.—The Newport News & Mississippi Valley R. R. Co. will build a new iron bridge over New river, to replace the one recently washed away.

Tyrone, Ky.—The Louisville Southern R. R. Co. has let a contract for a bridge over the Kentucky river; it is to be completed by April next.

Fayetteville, N. C.—The Cape Fear & Yadkin Valley R. R. will let contracts for masonry and iron superstructure for a bridge across the Cape Fear river.

Columbus, Miss.—The Kansas City, Memphis & Birmingham R. R. Co. will erect an iron bridge over the Buttahachie river on the Columbus branch.

Jeffersonville, Ind.—The city has petitioned the Secretary of War in favor of the original location of the proposed bridge of the Louisville & Jeffersonville Bridge Co.

Cairo, Ill.—The false work of the big bridge is being re-erected.—The iron bridge over Clear creek is nearly completed.

Argentine, Kan.—Arrangements have been made for the erection of a new county bridge, to replace the one recently condemned.

Kansas City, Kan.—An ordinance has been passed providing for the construction of a $5,000 bridge at Seventh St.

Portland, Ore.—Arrangements are being completed for beginning work on the wagon roadway approaches to the railroad bridge. The plans and specifications are all prepared and the work will be pushed to completion as speedily as possible.——The Willamette Iron Bridge Co. has declared a quarterly dividend of 2 per cent.

Chico, Cal.—A contract has been let by the Butte Co. Supervisors for a new bridge over Sandy Gulch, near Chico. The price is $6,350.

Laredo, Tex.—The Mexican National bridge across the Rio Grande is just completed.

WATER.

Yonkers, N. Y.—The report of the Water Commissioners for 1887, recently issued, shows that at the end of that year there were 33.38 miles of pipe, 372 hydrants and 227 gates. The Worthington engine at the low-service pumpings tation has been fitted with the high duty attachment, at a cost of $6,000; a saving of 20 per cent. of steam being guaranteed. At the high service station 14,503,824 galls. were pumped, at a cost of $11.43 per 1,000,000 galls.; at the low service station 770,802,470 galls. were pumped, at a cost of $12.96 per 1,000,000 galls. There are 1,537 meters. There were at the end of the year 49,910 ft. of sewers (exclusive of work under construction), with 233 manholes and 137 basins. Jos. A. LOCKWOOD is Superintendent.

Youngstown, O.—The Trustees of the Water-works have issued their report for the year ending March 31, 1888, being the sixteenth annual report. The pumping plant has been increased by a Deane pump of 5,000,000 galls. guaranteed daily capacity which at a test showed 20 per cent. above this capacity. A brick conduit, 154 ft. long, 50 in. inside diameter, 26 ft. under ground, with a valve chamber containing two 36-in. valves has been built, leading from the old well one rod from the river to the new well, which is 26 ft. deep and 10 ft. diameter, with a brick top 10 ft. high. The cost of pump and improvement was $21,812.42, and 3 miles, 2,974 ft. of pipe were laid at a cost of $17,649.76. The total pumpage was 517,537,515 galls. There are now 22 miles, 1,633 ft. of pipe and 279 hydrants. D. N. SIMPKINS is Secretary, and W. S. HAMILTON is Superintendent.

Burlington, Wis.—A meeting was held Sept. 8 to consider and discuss the practicability of water-works in Burlington. C. E. GRAY, a member of the Waukesha Village Board, explained the scheme and workings of a system of water-works, and thought the works could be put in at a cost not to exceed $30,000. He expressed the opinion that the best plan would be for a company to put in the system and furnish the village with a supply of hydrants for fire protection at from $1,800 to $2,400 per year. He thought a tank, stand-pipe or reservoir should be placed on the hill at the highest point, so as to be about 120 or 130 ft. above the level of Chestnut St., with 10-in. mains leading down to the several streets and continued in 8 and 6-in. pipes to 25 hydrants distributed throughout the village. Water can also be furnished for domestic purposes at a very reasonable charge. A committee of A. ZWIEBEL, GEO. H. WILBUR and W. A. COLBY, was appointed by the meeting to act in conjunction with the committee appointed by the Village Board, and to thoroughly investigate the matter of fire protection and especially water-works systems, and to report at a meeting of the Joint Committee to be held later.

Electric Lighting.—***Belfast, Me.***—The Thomson-Houston Electric Co. will put in a plant, with an engine of 100 H. P.

Pawtucket, R. I.—The town has appropriated $70,000 for an electric light plant.

Canastota, N. Y.—The Canastota Electric Light & Power Co. is putting up its building.

Kinderhook, N. Y.—An electric light system is contemplated.

Morristown, N. J.—The Morristown Electric Light Co. has put in a 250 H. P. vertical boiler, 65 H. P. engine, and a 900 incandescent light dynamo, more than doubling the capacity of the former plant.

Tarentum, Pa.—The Tarentum Electric Light Co. has been incorporated by R. A. TRAVIS and others. Capital stock, $5,000.

Mt. Vernon, O.—The electric light plant will be in operation Sept. 29.

Marion, O.—An electric light franchise has been granted to G. W. ROBERTSON and G. E. TURNER.

Lexington, Va.—An electric light plant is to be put in by the Richmond Electric Light & Power Co.

Carlisle, Ky.—A plant is to be put in by the Edison Electric Light Co., of St. Louis, Mo.

Columbia, Tenn.—The Columbia Electric Light & Power Co. will erect a plant and furnish electric light and power to Columbia so soon as the Board of Mayor and Aldermen pass the ordinance. E. C. MCDOWELL, President.

Statesville, N. C.—An electric light system is proposed. Address D. A. MILLER or N. B. MILLS.

Decatur, Ala.—The present electric light plant is to be enlarged.

Crawfordsville, Ind.—About Oct. 1 the city will be lighted by electricity entirely. For the past three years the center of the city has been lighted in this way and now there will be seventy lights in operation. New electric works have been erected, with an engine of 230 H. P.

Indianapolis, Ind.—The Brush Electric Light Co. will have its plant for lighting the central part of the city in operation in a few weeks. Two new dynamos will be put in.

Ionia, Mich.—The incandescent electric light plant will soon be in operation.

Chicago, Ill.—The Merchants' Arc Light & Power Co., capital stock $30,000, has been incorporated by W. H. COLLINS, JOEL W. STEVENS and B. KEIGHLER.

Clinton, Ill.—The Clinton Electric Light & Power Co. has been incorporated by C. H. MOORE, R. BUTLER, F. U. BURROUGHS, and others. Capital stock, $25,000.

Helena, Mont.—The People's Electric Light Co. is at work on its plant.

El Paso, Tex.—The El Paso Electric Light Co. has been incorporated by J. J. GURDON and others. Capital stock, $50,000.

Greenville, Tex.—An electric light company has been organized. President, J. M. COOK.

Cleburne, Tex.—The Cleburne Electric Light Co. has been organized by E. M. HEATH and others. Capital stock, $25,000.

Goderich, Ont.—The Council have decided to allow the Reliance Electric Light Co., of Waterford, to put in their machinery as a test for one year, in consideration of their tender being greatly beneath those of other companies.

Water-Works.—***Maine.***—Portland. The water is being removed from the reservoir on North Street.

New Hampshire,—Dover. Work is now progressing on the new water-works.

Massachusetts.—Amherst. A reservoir dam is to be constructed. F. W. HENDRICK has the contract.——Springfield. A large main burst on the 24th inst. causing several thousand dollars worth of damage. New hydrants are being set.——Ware. The new water supply is giving excellent satisfaction, notwithstanding the consumption is rapidly increasing.

Connecticut.—Hartford. The new line of pipe has been successfully laid across the river, and steam drilling is now being done on the ledges near the reservoir. The recent heavy rains have had but little effect upon the Farmington and West Hartford reservoirs.

New York.—Albany. The 44-in. cast-iron conduit leading from the receiving basin to the pumping house under which the caisson will be placed has been completed, tested and found air-tight. The 15-in. centrifugal pump, capacity 15,000,000 galls. will be attached to the caisson as soon as it is in position. The test will then be made, which will probably be some time in November. Work was begun Aug. 20, 1887, by W. D. Andrews & Bro.; 325 wells have been sunk to date.——Buffalo. A large main has been laid from the pumping station to East Buffalo and connections made between this and the mains on the hill just above the pumping station.——Haverstraw. The water-works are being changed from a pumping to a gravity system. W. B. RIDER is Chief Engineer.——Sandy Hill. The work is progressing rapidly under the supervision of W. B. RIDER. H. E.——Saratoga. Plans for the addition to the Loughberry water-works building, in which will be located the 8,000,000 gallon GASKELL engine, have been completed.——Springville. The Water-Works Co., is to supply the Institute buildings with pure spring water.—— Rochester. Sources for an increased water supply are being investigated. The city has outgrown its present works. J. NELSON TUBBS, Chief Engineer.

Pennsylvania.—Lancaster. The new water-works well has been completed, the gates at the conduit are now tight and preparations are being made to test the pumps, which will be at an early date.

New Jersey.—Jersey City. The Board of Public Works have been asked to extend the water mains on Eighth, Long and Leonard streets.——Paterson. Complaints are being made of the water brought from the present source of supply and something will probably be done soon to secure purer water.

Maryland.—Union Bridge, The new reservoir has been completed and the water-supply has been more than doubled.

Dist. of Columbia.—Washington. It is again proposed to supply Potomac river water free to the people of Washington.

Ohio.—Sidney. The contract to rebuild the water-works has been awarded by the Board of Trustees. It will embrace a new steel stand-pipe of 3,000,000 gallons capacity, new mains, hydrants, valves, etc.

Indiana.—Wabash. Extensions and improvements are now being made to the water-works. A remarkable flowing well has been struck, from which a pipe is now being laid to the reservoir.——Indianapolis. Recommendations have been made looking toward increasing the water-supply from subterranean sources and from the river.

Ontario.—Walkerville. Health Office: Dr. Coventry says that the sewerage from that town will in time make the water dangerously impure. He is in favor of a site above Walkerville for the new water-works building. So also are the Town Council and the public generally, and if $1,000,000 will cover the expenses that is where it will probably be. A competent engineer will be employed to estimate the cost.——Windsor. Water mains on Pitt Street and Langlois Avenue will be laid at once.

Illinois.—Peoria. The Steam Heating & Power Co.'s ordinance has been favorably voted upon. The officers are: P. L. SHUMAN, of Chicago; J. S. LEE and J. D. MCCLURE, Peoria.——Lacon. A vote favoring the acceptance of G. W. REEVE'S, (Peru), proposition has been cast by the council. The feeling generally is in favor of water-works, though some of the tax-payers have entered a protest.——Chicago. The crib for the new water-works will be launched about Oct. 1.——Hyde Park. The Water Commissioner has been instructed to purchase for immediate delivery 120 tons of cast-iron water-pipe. The Board of Trustees will soon let the contract for the pumping machinery.——Evanston. Water-pipes are now being laid at North Evanston. Charles Bennington is superintending the work.——Princeton. The work on the new well is progressing very satisfactorily.——Lake View A tunnel under the lake with an exposed crib at the en of it to cost $115,000, is now projected.

Iowa.—Burlington. Work has begun on the third a tesian well, and the well at RAND'S park is being sun 200 ft. deeper to secure a heavier flow of water.

Missouri.—St. Charles. The St. Charles Water Co. is now cleaning its wells, tanks and mains.

Kansas.—Wellington. The plant and franchise of the Wellington Water Works have been turned over to a representative of the Eastern holders of $100,000 worth of the company's bonds, an understanding having been arrived at between the company and its creditors to this effect, and the former will not resist the suit for foreclosure now pending in the United States Circuit Court. JOSEPH THRALLS, of this city, has been appointed Receiver, and will take charge of the works at once.

Nebraska.—Lincoln. The city has outgrown the water-works, and active steps are being taken to put in a new system. W. J. COOPER is Chairman Water Committee.

Colorado.—Pueblo.—JOHN MONTGOMERY, DONALD FLETCHER, and others, interested in Fountain Heights, a 640-acre tract of land half a mile east of the city, have concluded to put in water-works.——Grand Junction. Work has been commenced on the water-works system, and will be completed in the course of the next 60 or 90 days.

Minnesota.—Winona. Improvements and repairs are to be made to the water-works. Trusses for covering the well will be purchased. City Engineer FELLOWS has submitted plans.

Texas.—Galveston. Well No. 4, at a depth of 788 ft. is furnishing 200,000 galls. per 24 hours. An extension of time, in which to complete the contract is now being asked for by Mr. SIEGEL, the contractor.——Sierra Blanca. The Texas & Pacific Railroad Co. are to sink an artesian well.——Van Horn. One of the wells just finished, furnishes 24,000 galls. per day at a depth of 600 ft. Combined capacity of the 3 wells, 75,000 galls. per day.——Sherman and Fort Worth. The wells have not been completed. Work is now in progress.

California.—Santa Cruz. The people have voted to issue $300,000 worth of bonds for the purchase of water-works.——Wheatland, Yuba Co. $3,000 have been subscribed toward a water works system for the town.——Sacramento. New sources for an increased water supply are being actively discussed. Address P. E. PLATT, of Board of Trade.

Canada.—Toronto. SAMUEL. M. GRAY, City Engineer, of Providence, R. I., has been appointed to investigate the question of a full and efficient water supply.

Madison, Wis.—The Common Council has adopted the following resolution: "That the city mayor and city clerk be instructed to enter into a contract with Gilman, Woodward & Hudson, composing the electric light company, to the purpose that the said Gilman, Woodward & Hudson erect, maintain and operate twenty-two lights of 1,200-candle power, at such places as recommended by the special committee, at a cost not to exceed the schedule rate contained in their proposition to said special committee, for a period not to exceed one year from date of said contract; and also to enter into a contract with the Madison City Gas Light & Coke Co., for furnishing gas for street illumination for a year ensuing the making thereof, in accordance with the recommendation of the special committee."

Faribault, Minn.—The water-works well is 20 by 30. ft. and supplies two pumping engines with a daily capacity of 1,000,000 galls. each. The water is pumped to a reservoir at an elevation of over 200 ft.; this reservoir is 80 by 23 ft. and has a capacity of nearly 1,000,000 galls. There are 7 miles of mains and 59 hydrants. The city has an incandescent electric light plant and gas works. There are 7 bridges over the Straight river.

Drainage in Wisconsin.—The application for the appointment of drainage commissioners for Dane Co., has been denied by Judge STEWART on the ground that the proposed system would not be of permanent public benefit, that for a considerable time it would be likely to be detrimental to public health, and that the costs, damages and expenses would be more than the benefits that would result to the owners of land likely to be benefited thereby.

Irrigation.—VAN AUKEN & MEAD, of Denver, Col., are the engineers for an irrigating system in New Mexico, to reclaim 100,000 acres of land. The main ditch is to be 40 ft. wide on the bottom, 8 ft. deep and between 40 and 50 miles long. There will be no flumes, but one tunnel 1360 ft. long.

They are also perfecting arrangements to make examinations and preliminary surveys to determine the practicability of two different irrigating systems, one to reclaim 8,000 acres, and the other about 20,000 acres.

East Orange, N. J.—MR. WILEY, Chairman of the East Orange Township Committee, has sent the following communication to the Common Council of Orange:

"Will you kindly inform me on what basis the city water-works of Orange will supply the hydrants of East Orange Township with water, guaranteeing a pressure of 300 ft. above tide water? This is the present guarantee of the Orange Water Co., but, I regret to say, I do not find it carried out; at least at the last four or five fires we have failed to get it. The township has between 200 and 300 hydrants, and is known to be a prompt paymaster; hence, ought to obtain the best service possible. As soon as I hear from you I will lay the matter before the Township Committee. We shall also require to have 80 flush tanks supplied with water for our sewerage system."

Cleveland, O.—The Board of Health has sent a communication to the Common Council calling attention to the contamination of the water supply by sewage. During the year 1887 and a portion of the current year, a series of careful and competent chemical examinations of the water supply of the city were made, under the direction of the Water-Works Trustees and Board of Health. The reports and results of such examinations have been published and neither the methods employed or results obtained have been questioned. The practical and vital point of interest in these reports to the people of the city is, that the analyses show a degree of contamination of the water supply, at times, which may well cause anxiety to the users of lake water. The source of such contamination is suggested, if not proved, by these analyses to be from the sewage carried out into the lake by the waters of the Cuyahoga river.

The injurious effect of sewage in the river is likely to be vastly increased in intensity and extent of distribution, if it reaches the water supply, as compared with distress to any business or persons, by odors and gases escaping along its course. For this reason it would appear unwise to delay preparations or action in whatever engineering plans may be necessary to keep the river free from sewage at all seasons of the year and the Board urges against any delay or hesitation. So far as has been suggested, some form of intercepting sewer would appear to be the most efficient measure for this purpose.

"We therefore urge upon you the necessity for prompt and persistent action to secure a conduit, with outlet for all the sewage of city at some point as far from the point of 'intake' in our waterworks system, both in respect to distance and currents, as the location of our city will permit. Simply 'flushing' the river 'naturally' or 'artificially,' carrying the sewage it bears out farther and more freely, may relieve the few, but, under present conditions, adds danger to the many."

Syracuse, N. Y.—The Syracuse Water Co. is conducting a pumping test of the wells in the valley and is meeting with success. The water is drawn from 32 gang wells, each sunk to a depth of 40 ft. The first 16 ft. is clay, then 4 ft. of hard-pan, and below this is a bed of pure, clean, water-worn gravel, free from sand. The appearance of the gravel indicates a subterranean stream of water commensurate with the vast watershed of the valley. The temperature of the water is 48°. The wells are situated 50 ft. apart, alternating on each side of an iron collecting main. The size of the pipe in each well is 6 ins. The 24 new wells are upon two collecting mains, each 600 ft. in length, which unite just outside the larger of the two pumping houses. They are operated by two new engines, each of 58 H. P. The collecting mains are 12 ins. in diameter at the pumping house, gradually diminishing in size to 10, 8 and finally at the extreme ends to 6 ins. The other eight wells, which were sunk last winter, are upon a separate collecting main, operated by the engines in the smaller pumping house. This smaller system was constructed with the expectation of obtaining 1,000,000 galls. per day, but its operation was so successful, the actual amount pumped being 2,500,000 galls., that the company felt encouraged to make experiments on a much larger scale. The water is now allowed to run off into the creek. It is proposed to run it in a 36-in. main through Midland avenue to the pumping station and thence to force it into the city mains. A high service system is contemplated for James street and University Hill. The amount now being pumped is about 10,500,000 galls. per 24 hours, about 25 per cent. more water than the present consumption of the city. The water is of excellent quality.

Reading, Pa.—The Board of Water Commissioners have submitted to the City Councils a supplemental report relative to the Maiden creek water supply, and to this report is appended another, by Mr. HOWARD MURPHY, Civil and Hydraulic Engineer, of Philadelphia, upon the question of the future water supply of the city. MR. MURPHY has made a careful general examination of the water question and states that the means of supply should be largely increased. The present consumption is 5,000,000 galls. per day. The advisability of increasing the storage capacity of the present sources has been considered, but is not favorably reported upon; the increasing of the height of the present dams is considered inadvisable and proper additional dams would cost $100,000; this would give an increased supply that would only suffice for short time, and the total cost of this work would be about $270,000. The other sources considered are the Schuylkill river, and the Maiden creek, for the Tulpehocken creek will not yield a pure water. Mr. MURPHY recommends that the Maiden creek be adopted as the source of Reading's additional water supply, that a pumping station be erected and furnished with the most approved plant with a capacity of at least 10,000,000 galls. per day with a fire pressure of 100 lbs., the machinery to consist of two independent engines; that a dam be built to prevent the Schuylkill water from entering the suction pipe, and that a 30-in. cast-iron main be laid from the engine house to the city. This extension will cost about $198,000. Anything less than the work recommended will be only trifling with the water question. The Maiden creek has a magnificent water shed of 226 sq. miles and a flow of about 200,000,000 galls. per day. The reinforcement of the present distribution system, which has already been attempted by the Water Commissioners will have to be continued and completed.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

ELLICOTTVILLE, N. Y., Sept. 22, 1888.

EDITOR ENGINEERING NEWS:—The population of this town is 1,000, and at present we have no mode of water supply. There has been some talk of organizing a Water Co., and putting in a small system of water-works to cost from $3,000 to $5,000, but no money has been raised and nothing done as yet. There is a good chance for some one to put in water-works. M. W. KIERNAN.

SEABRIGHT, N. J., Sept. 22, 1888.

EDITOR ENGINEERING NEWS:—The construction of water-works was begun in Dec. 1887, and completed July 1, 1888. Supply is obtained from artesian wells. The works were built by a stock company, of which J. R. MINUGH is President, at a cost of $25,000; money is being raised by subscription. Population is 1,000.
C. H. DEDERER.

AURORA, Neb., Sept. 15, 1888.

EDITOR ENGINEERING NEWS:—Bids will be opened and contracts let for the construction of a system of water-works, Sept 21.

CARTHAGE, N. Y., Sept. 18, 1888.

EDITOR ENGINEERING NEWS:—The present source of water supply is from the Black river; the water being stored in 14 large reservoirs. A vote is to be taken Sept. 29, 1888, to decide the question of establishing a system of water-works to cost $75,600, consisting of 6 miles of mains, and 60 hydrants. Supply to be taken from Pleasant Lake. The proposition will probably be defeated. Present population is 4,500. H. HUNGERFORD, of New York City, is at the head of the enterprise, and if works are put in it will probably be by the "Carthage Water Supply Co." W. H. KESLER, *Village Clerk.*

CLYDE, N. Y., Sept. 17, 1888.

EDITOR ENGINEERING NEWS:—A system of water-works is now being constructed in this place by Bassett Bros., of Buffalo, N. Y. Works are to be owned and controlled by the Clyde Water Supply Co. The officers are C. R. BASSETT, President; E. M. BASSETT, Secretary. Supply will be taken from springs and wells and there will be 5 miles of pipe. Bonds to the amount of $50,000 will be issued. Franchise is for 5 years with hydrant rental of 1,600 per year. Population, 3,500. The supply will be taken from wells and pumped to a stand-pipe or reservoir. Probable cost of works when completed, $25,000, for which amount the city will be bonded. The engineer has been engaged to make surveys. DELEVAN BATES is Mayor. Population 1,500.
WM. P. HELLINGS, *City Clerk.*

OBERLIN, Kan., Sept. 17, 1888.

EDITOR ENGINEERING NEWS:—BENJ. D. CLARK, Tecumseh, Neb., has contract and is now putting in a system of water-works. Supply is obtained from 32 3-in. tubular wells, 35 ft. deep. Probable cost, $25,000. Surveys were made by A. A. RICHARDSON, Lincoln, Neb. A stand-pipe 12 × 100 ft. is to be erected on a hill of 75 ft. elevation, from which a pressure of 75 lbs. will be obtained. By a cut-off at base of standpipe direct pressure can be obtained. Estimated annual expenses, $2,000. Revenue, $2,300. Population 1,800.
GEO. W. KEYS, *City Clerk.*

LAS ANIMAS, Colo., Sept. 15, 1888.

EDITOR ENGINEERING NEWS:—On Tuesday Oct. 3, our town will vote on the question of issuing $30,000 bonds for the purpose of building a system of water-works.
HORACE E. COLLINS, *Clerk.*

RICH HILL, Mo., Sept. 22, 1888.

EDITOR ENGINEERING NEWS:—I began work on the Cullison, Kan., water-works July 1, 1888, and completed them Aug. 15, 1888. Supply is from a well 18 ft. in diameter, 110 ft. deep. The water is pumped by a 400,000 gall. Knowles pump to a tank and can also be pumped direct. Pipe was furnished by RIPLEY & BRONSON, St. Louis, Mo., and the valves and hydrants by the CHAPMAN VALVE MFG. CO., Indian Orchard, Mass. There are 1½ miles of pipe, 30 taps and 8 hydrants. Ordinary pressure is 30 lbs. Fire pressure, 90 lbs. Cost of works $6,500. Bonded debt $6,500 at 7 per cent. interest. The well, pump and tank are owned by the Wichita Western R. R. Co., they agreeing to furnish water to the city for fire and domestic purposes at 10 cts. per 1,000 galls. Water to run through a 4-in. meter connected to a 6-in. main. The city laid 3,000 ft. of 6-in.; 2,200 ft. 4-in.; 2,000 ft. 2-in. pipe. In case of fire the water is shut off from the meter and goes direct to mains. The town pays $400 per year for this fire protection. Population 500.
GUIDO JAEGER, *Contractor.*

RECORD OF NEW WATER WORKS CONSTRUCTION.

(Specially communicated).

CONTINUED FROM PAGE 238.

Pennington, N. J.—The works were commenced in November, 1886, and completed January 1, 1888. They were designed and built by D. A. CLARKSON. The pipe, specials and Eddy valves were supplied by R. D. Wood & Co., of Philadelphia. The water is taken from a spring water vein about 6 ft. wide at the base of a mountain, and the supply is by gravity. There is a reservoir 110 ft. × by 75 ft., oval, 20 ft. deep in the center. There are 3 miles of pipe and about 60 taps; 1 meter; no hydrants; the mains are of 4 in. cast-iron pipe, and the services of ¾-in. galvanized pipe. Average daily consumption, 20,000 galls. Ordinary and fire pressure, 20 lbs. Cost of works, $9,000; no debt. The annual expenses are as yet very light. The franchise is perpetual. The works are owned by the Pennington Spring Water Co.; President, D. A. CLARKSON; Secretary, JOHN J. MUIRHEID. Capital stock, $10,000. The present population is 700. The village had long needed a good supply of water, and such a supply was found about 2½ miles from the village, at an elevation of about 50 ft. above the highest part of the town. The water is brought down through a 4-in. pipe; the ditch is 4 ft. deep. The reservoir is built of clay and has a capacity of about 400,000 galls.; the water in it has not been lowered ¼ in. since it was built. Owing to the wet summer last year, the company did not have as many taps as it expected. The receipts of last year made 6 per cent. on the cost, and something over; an 8 per cent. dividend is expected at the end of this year. (Date of special report, June 7, 1888).

Holden, Mo.—The works were commenced in March, 1887, and accepted Dec. 23, 1887. The engineers were L. P. ANDREWS and J. B. QUIGLEY. The contract for construction was let to the Inter-State Gas & Water-Works Co., of St. Louis, Mo.: the pumping machinery was furnished by the Deane Steam Pump Co., of Holyoke, Mass.; the pipe and specials by the South St. Louis Foundry; the valves and hydrants, by the Chapman Valve Mfg. Co., of Indian Orchard, Mass.; and the stand-pipe by J. O'Brien & Co., of St. Louis, Mo. The supply is drawn from an impounding reservoir and pumped to a stand-pipe 127 ft. high and 10 ft. in diameter by duplex compound pumping engines of 1,250,000 galls. daily capacity; the boilers are of steel. There are 6¼ miles of pipe, 50 hydrants, 46 taps and 1 meter; the mains are of cast-iron and the services of lead and galvanized iron. Average daily consumption, 110,000 galls. Ordinary pressure, 60 lbs. Debt, $75,000; rate of interest, 6 per cent. The annual revenue from consumers is estimated at $4,000: from the city, $3,000. The franchise is for 20 years, with renewal unless the city purchases the works; the hydrant rental is $60 per hydrant per annum. The works are owned by the Holden Water-Works Co., President, L. P. ANDREWS; Secretary, A. SCHENCK; stock, $75,000; bonds $75,000. B. J. MILLER is Superintendent. The present population is 4,500. (Date of special report, Feb. 20, 1888).

(TO BE CONTINUED).